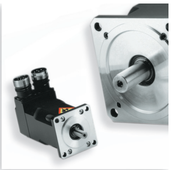
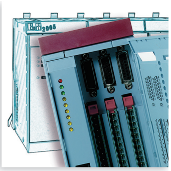
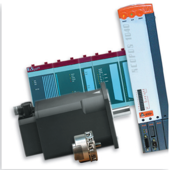
B&R Automation Studio
Version 1.0 SP1







ACOPOS
User´s Manual

ACOPOS

User's Manual

Version: **1.3.1 (April 2004)**
Mod. No.: **MAACP2-E**

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Chapter 1 • General Information

1. ACOPOS™

1.1 Speed and Precision

With the ACOPOS™ servo family, B&R provides the basis for complete and uniform automation solutions. Branch specific functions and intuitive tools allow for short development times and create more room for innovation.

A decisive criteria for automation solutions is a fast and precise reaction to events dependent on the application or immediate changes to the production process. Therefore, ACOPOS™ servo drives work with very short scan times and communication cycles of 400 µs, which only amount to 50 µs in the control loop.

1.2 Maximum Security

The ACOPOS™ servo family was tested thoroughly during the development phase. Under difficult conditions, such as heavy vibrations or increased temperatures, the devices were subject to loads that greatly exceed the values that occur in normal everyday operation.

READY
RUN
ERROR
ACOPOS 1045
X1

Figure 1: EMC test on the ACOPOS™ servo drives - maximum security for the user

EMC was given special attention to facilitate use in a rough industrial environment. Field tests have been carried out under difficult conditions in addition to the tests defined in the standard. The results confirm the excellent values measured by the testing laboratory and during operation.

The necessary filters, which meet CE guidelines, are also integrated in the device.

Using computer-aided models, the thermal behavior of the entire system is pre-calculated based on measured currents and temperatures. This results in maximum performance by taking advantage of the system's full capabilities.

ACOPOS™ servo drives use the information on the motor's embedded parameter chip, which contains all relevant mechanical and electronic data. The extensive and error-prone task of setting parameters manually is no longer necessary and start-up times are substantially reduced. During service, relevant data can be requested and the cause of problems that may exist can be determined.

1.3 Modular, Precise and Communicative

The I/O points needed to operate a servo axis are part of the standard equipment for ACOPOS™ servo drives. The user is provided two trigger inputs for tasks requiring precise measurements or print mark control.

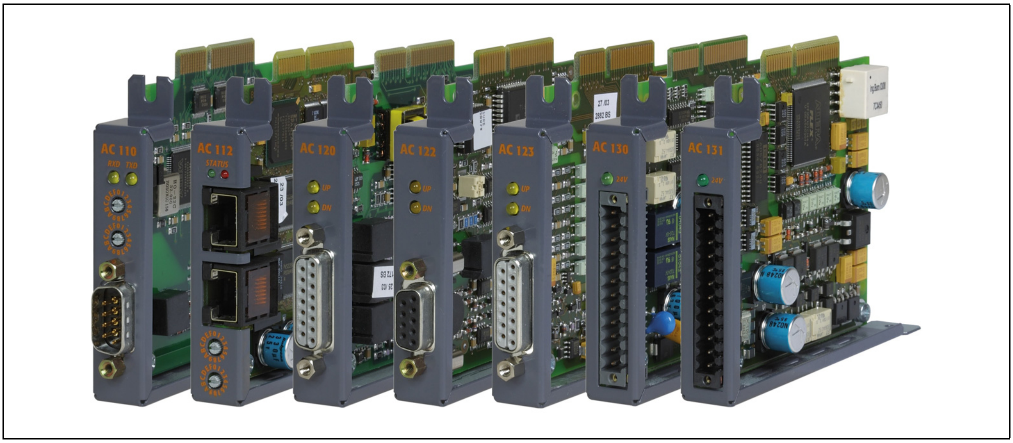
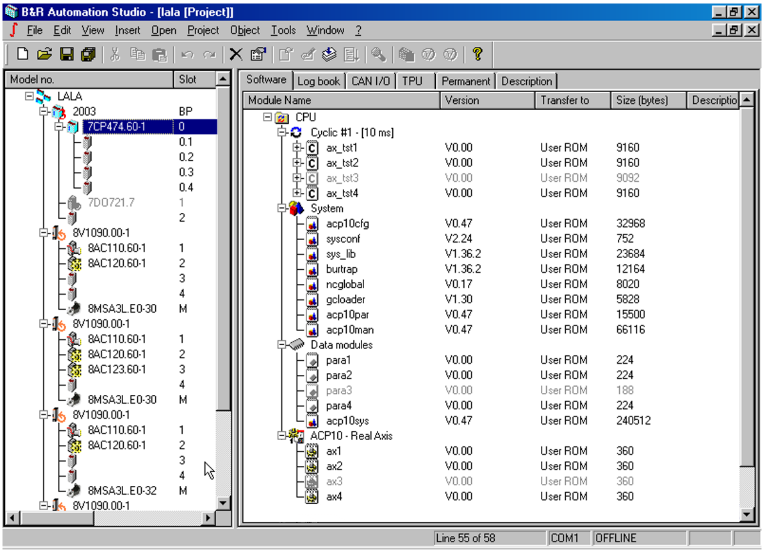


Figure 2: Plug-in modules allow optimized, application-specific configuration of ACOPOS™ servo drives

Further configuration of the ACOPOS™ servo drive to meet the respective application-specific demands takes place using plug-in modules. Plug-in modules are available to make network connections with other drives, controllers and visualization devices as well as for the connection of encoders, sensors and actuators. Additionally, CPU modules for controller and drive integration (drive-based automation) are also available.

1.4 Configuring Instead of Programming

ACOPOS™ servo drives can be configured for demanding positioning tasks such as electronic gears or cam profiles. Based on long-term cooperation with customers from all over the world, B&R shares its know-how in the form of compact function blocks for many applications. Industry-specific functionality can be quickly and easily implemented in an application program.


B&R Automation Studio - [lala [Project]]
File Edit View Insert Open Project Object Tools Window ?
Software
Log book
CAN I/O
TPU
Permanent
Description
Line 55 of 58
COM1
OFFLINE

Model no.	Slot
LALA	
2003	BP
7CP474.60-1	0
	0.1
	0.2
	0.3
	0.4
7D0721.7	1
	2
8V1090.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
8MSA3L.E0-30	M
8V1090.00-1	
8AC110.60-1	1
8AC120.60-1	2
8AC123.60-1	3
	4
8MSA3L.E0-30	M
8V1090.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
8MSA3L.E0-32	M
8V1090.00-1	

Module Name	Version	Transfer to	Size (bytes)	Descriptio
CPU				
Cyclic #1 - [10 ms]				
ax_tst1	V0.00	User ROM	9160	
ax_tst2	V0.00	User ROM	9160	
ax_tst3	V0.00	User ROM	9092	
ax_tst4	V0.00	User ROM	9160	
System				
acp10cfg	V0.47	User ROM	32968	
sysconf	V2.24	User ROM	752	
sys_lib	V1.36.2	User ROM	23684	
burtrap	V1.36.2	User ROM	12164	
ncglobal	V0.17	User ROM	8020	
gcloader	V1.30	User ROM	5828	
acp10par	V0.47	User ROM	15500	
acp10man	V0.47	User ROM	66116	
Data modules				
para1	V0.00	User ROM	224	
para2	V0.00	User ROM	224	
para3	V0.00	User ROM	188	
para4	V0.00	User ROM	224	
acp10sys	V0.47	User ROM	240512	
ACP10 - Real Axis				
ax1	V0.00	User ROM	360	
ax2	V0.00	User ROM	360	
ax3	V0.00	User ROM	360	
ax4	V0.00	User ROM	360	

Figure 3: Configuring ACOPOS™ servo drives using B&R Automation Studio™ guarantees fast and easy implementation of application requirements

1.5 PLCopen Motion Control Function Blocks

The area of motion control is one of the central topics in automation technology. This is partly due to its high portion of the entire automation expenses and the resulting savings potential.

The PLCopen motion control function blocks (conforming to IEC 61131-3) support the user when implementing these possibilities by providing vendor-independence and reducing development times. The user can choose between the programming languages Ladder Diagram (LD), Structured Text (ST) and the high-level language "C".

The function range of the function blocks is divided into the areas of single and multi-axis movements. In addition to the usual relative and absolute movements, the first of the two areas also includes the possibility of overlapping movements. In the area of multi-axis movements, functions such as gears, cam profile functions, up/down synchronization and differential gear (changing phase angles) are supported.

1.6 Smart Process Technology

Smart Process Technology meets the customer’s need for cost-effective solutions and high production speeds. This freely configurable technology library, is homogenously integrated into the existing Motion Control product.

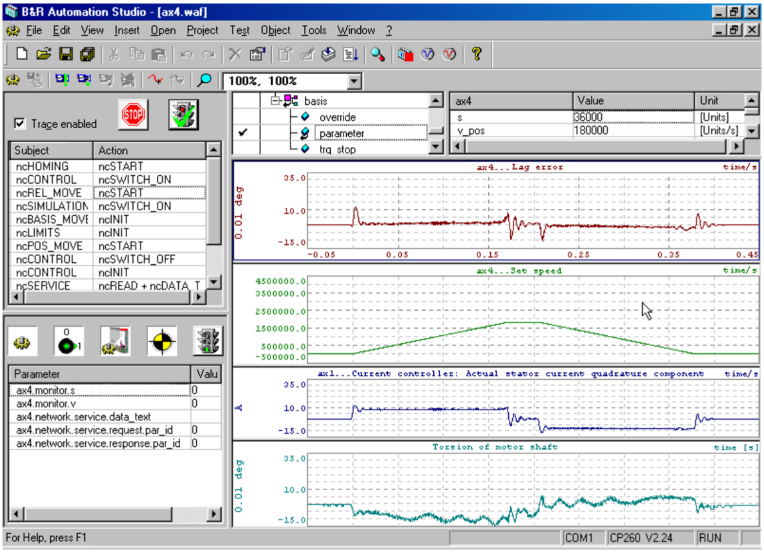
Using indirect process parameters makes it possible to eliminate sensors, which are often not fast enough to keep up with high production speeds. Synchronous processing and short response times make it possible to achieve excellent productivity and precision. For example, highly efficient and intelligent decentralized units allow seamless quality control. In the field, this significantly reduces cycle times while improving component quality.

This meets the requirements of modern motion control products such as high product quality, machine productivity along with short maintenance and down times and, to a greater extent, seamless quality control during production.

1.7 A Unit Made Up of Hardware and Software

Programming all B&R products takes place in a uniform manner in B&R Automation Studio™ with Windows look and feel. Complex drive solutions can be created after a short orientation period. Adding hardware components and program sections, as well as their configuration, is done in dialog boxes; this reduces project development times considerably.

Axis movements can be checked without programming using NC Test. All types of movements, ranging from point-to-point to gear functions, can be carried out interactively. The reaction of the axis can be seen online in the monitor window. The trace function records relevant drive data for clear evaluation.


B&R Automation Studio - [ax4.waf]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
☑ Trace enabled
STOP
basis
override
parameter
trq_stop
ax4...Lag error
time/s
0.01 deg
35.0
10.0
-15.0
-0.05
0.05
0.15
0.25
0.35
0.45
ax4...Set speed
time/s
4500000.0
3500000.0
2500000.0
1500000.0
500000.0
-500000.0
ax1...Current controller: Actual stator current quadrature component
time/s
A
35.0
10.0
-15.0
Torsion of motor shaft
time [s]
0.01 deg
35.0
10.0
-15.0
For Help, press F1
COM1
CP260 V2.24
RUN

Subject	Action
ncHOMING	ncSTART
ncCONTROL	ncSWITCH_ON
ncREL_MOVE	ncSTART
ncSIMULATION	ncSWITCH_ON
ncBASIS_MOVE	ncINIT
ncLIMITS	ncINIT
ncPOS_MOVE	ncSTART
ncCONTROL	ncSWITCH_OFF
ncCONTROL	ncINIT
ncSERVICE	ncREAD + ncDATA_T

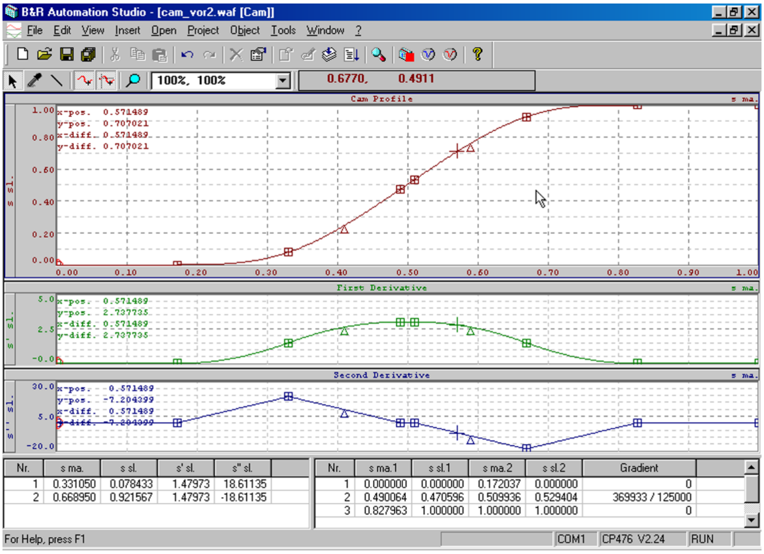
ax4	Value	Unit
s	36000	[Units]
v_pos	180000	[Units/s]

Parameter	Valu
ax4.monitor.s	0
ax4.monitor.v	0
ax4.network.service.data_text	
ax4.network.service.request.par_id	0
ax4.network.service.response.par_id	0

Figure 4: Optimal control of the movement using NC Test and Trace function

1.8 Real-time Movement Analysis

The drive is monitored in real-time using the oscilloscope function. Many trigger possibilities generate informative data for analysis of the movement during operation. The graphic display allows the user to make fine adjustments and optimizations of the movement in the microsecond range. The integration of powerful tools, such as the cam editor, reduces programming for complex coupled movements to simple drag-and-drop procedures. The results and effects on speed, acceleration and jolt can be immediately analyzed graphically.


B&R Automation Studio - [cam_vor2.waf [Cam]]
File Edit View Insert Open Project Object Tools Window ?
100%, 100%
0.6770, 0.4911
Cam Profile
s ma.
s sl.
1.00
0.80
0.60
0.40
0.20
0.00
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
x-pos. 0.571489
y-pos. 0.707021
x-diff. 0.571489
y-diff. 0.707021
First Derivative
s ma.
s' sl.
5.0
2.5
-0.0
x-pos. 0.571489
y-pos. 2.737735
x-diff. 0.571489
y-diff. 2.737735
Second Derivative
s ma.
s'' sl.
30.0
5.0
-20.0
x-pos. 0.571489
y-pos. -7.204399
x-diff. 0.571489
y-diff. -7.204399
For Help, press F1
COM1
CP476 V2.24
RUN

Nr.	s ma.	s sl.	s' sl.	s" sl.
1	0.331050	0.078433	1.47973	18.61135
2	0.668950	0.921567	1.47973	-18.61135

Nr.	s ma.1	s sl.1	s ma.2	s sl.2	Gradient
1	0.000000	0.000000	0.172037	0.000000	0
2	0.490064	0.470596	0.509936	0.529404	369933 / 125000
3	0.827963	1.000000	1.000000	1.000000	0

Figure 5: Cam editor - create movements simply and precisely

1.9 ACOPOS™ and CNC Applications

The integrated "Soft" CNC system from B&R unites all of the software components necessary for machine automation in a 64-bit processor platform, which means sufficient computing power even for complex processing machines. The integrated system architecture, together with ACOPOS™ servo drives, provides many opportunities regarding reaction speed, data throughput and precision and reduces costs at the same time.

- Uniformly integrated ACOPOS™ servo drive technology
- Powerful and fast-reacting
- Unlimited flexibility of PLC and CNC systems provides room for automation ideas
- 8 independent CNC channels
- Up to a total of 100 axes for positioning, CNC, electronic gears
- Individual graphic interface
- Almost unlimited system memory for programs, diagnostics, and process data
- Internet or intranet connection for inspection or remote maintenance

Leading manufacturers of water jet, laser and torch cutting production technologies are already utilizing these technological advantages.

2. ACOPOS™ Configurations

2.1 General Information

ACOPOS™ servo drives can be used in various configurations depending on the network type and the requirements of the application.

The following ACOPOS™ functions are possible for all configuration examples:

- Point-to-point
- Electronic gears
- Electronic compensation gears
- Cross cutters
- Electronic cam profiles
- Flying saws
- Line shaft
- CNC

2.2 ACOPOS™ in ETHERNET Powerlink Network

High-performance machine architectures require flexible networks and field busses. With ETHERNET Powerlink, a network is available to the user that fully meets the high demands of dynamic motion systems. ETHERNET Powerlink adapts to the requirements of the machine and the system. The rigid coupling of many axes with controllers, industrial PCs, I/O systems and operator panels allows machines and systems to be created with the highest level of precision. Compatibility to standard Ethernet also reduces the number of networks and fieldbusses on the machine level.

2.2.1 Recommended Topology

In the Powerlink network (seen from the manager), the tree structure should always come first followed then by the line structure. Otherwise, the line structure delay affects the entire tree beneath it.

> ## Information:
>
> **It should be noted that the longest path is allowed a maximum of 10 hubs by the manager.**

2.2.2 Further Literature

Unless otherwise stated, the recommendations in the following documents apply:

- "Industrial Ethernet Planning and Installation Guide", Draft 2.0, IAONA (www.iaona-eu.com)
- "Guide to Understanding and Obtaining High Quality Generic Cabling", 3P Third Party Testing (www.3ptest.dk)

2.2.3 ACOPOS™ in ETHERNET Powerlink - Star Structure

ACOPOS™ servo drives are connected to the ETHERNET Powerlink network in star-form using hubs.

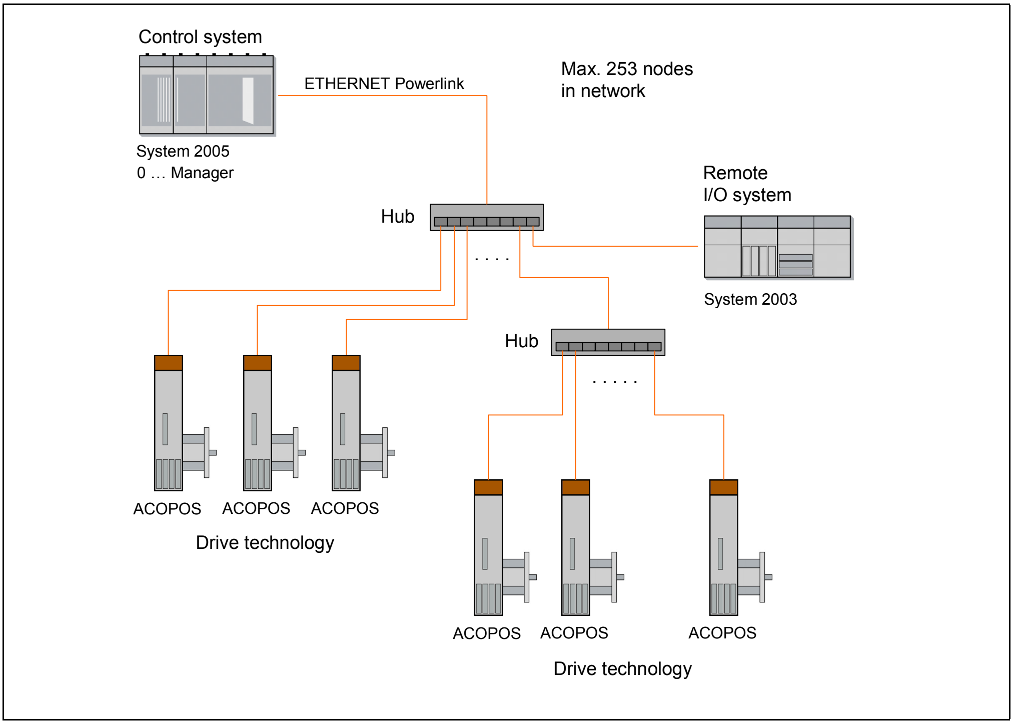

Control system
ETHERNET Powerlink
Max. 253 nodes
in network
System 2005
0 … Manager
Remote
I/O system
Hub
. . . .
System 2003
Hub
. . . . .
ACOPOS
ACOPOS
ACOPOS
Drive technology
ACOPOS
ACOPOS
ACOPOS
Drive technology

Figure 6: ACOPOS™ in ETHERNET Powerlink star structure

2.2.4 ACOPOS™ in ETHERNET Powerlink - Line Structure

All ACOPOS™ servo drives serve as mini-hub for cabling, and allow line-formed routing of the ETHERNET Powerlink network. This considerably reduces the cabling expenditure (without reducing functionality).

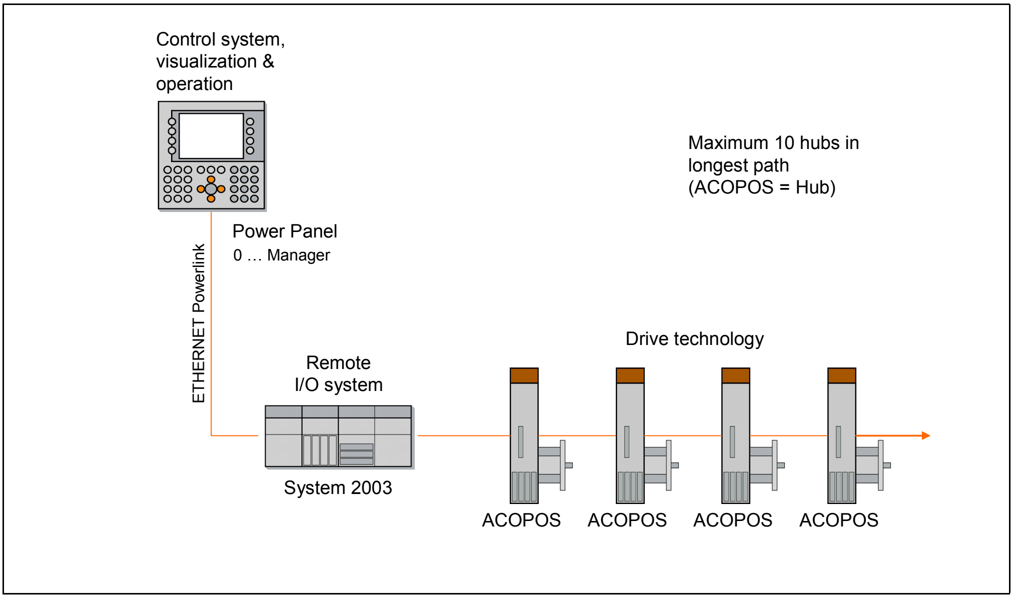

Control system,
visualization &
operation
Maximum 10 hubs in
longest path
(ACOPOS = Hub)
Power Panel
0 … Manager
ETHERNET Powerlink
Drive technology
Remote
I/O system
System 2003
ACOPOS
ACOPOS
ACOPOS
ACOPOS

Figure 7: ACOPOS™ in ETHERNET Powerlink line structure

2.2.5 ACOPOS™ in ETHERNET Powerlink - Mixed Structure

ACOPOS™ servo drives are connected to the ETHERNET Powerlink network in both star-form using hubs and line-form.

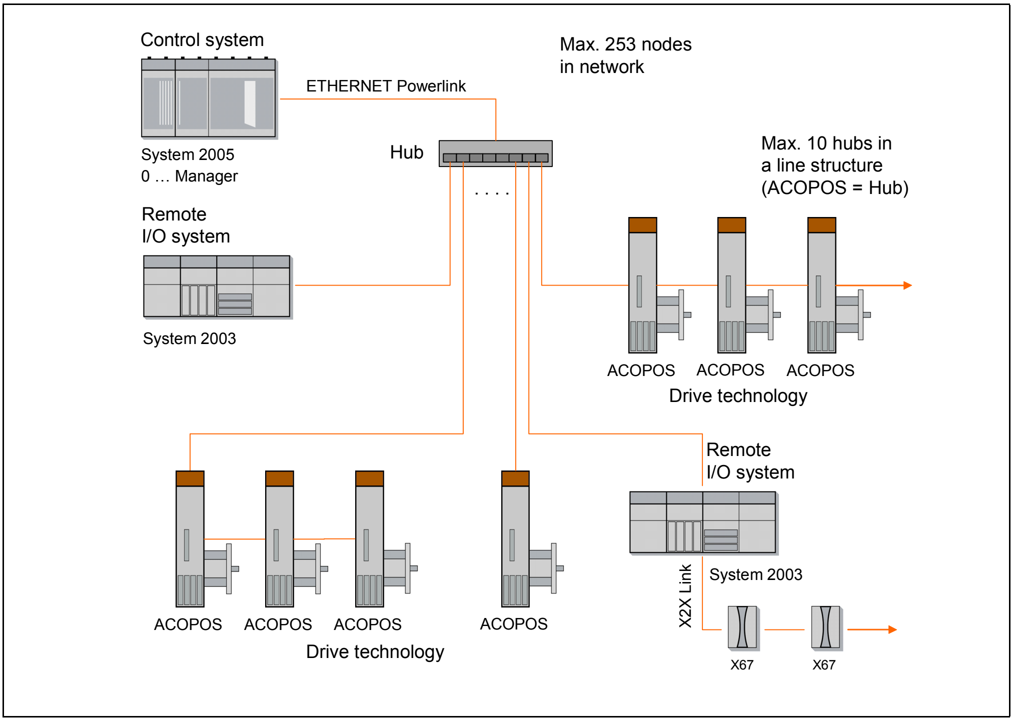

Control system
Max. 253 nodes
in network
ETHERNET Powerlink
Hub
System 2005
0 … Manager
Max. 10 hubs in
a line structure
(ACOPOS = Hub)
. . . .
Remote
I/O system
System 2003
ACOPOS
ACOPOS
ACOPOS
Drive technology
Remote
I/O system
System 2003
X2X Link
ACOPOS
ACOPOS
ACOPOS
ACOPOS
Drive technology
X67
X67

Figure 8: ACOPOS™ in mixed ETHERNET Powerlink structure

2.3 ACOPOS™ on the CAN Bus

CAN bus is a cost-effective fieldbus for networking ACOPOS™ servo drives with controllers, industrial PCs, I/O systems and operator panels.

The dynamic requirements for small and mid-sized machines with several axes can be handled ideally using CAN bus.

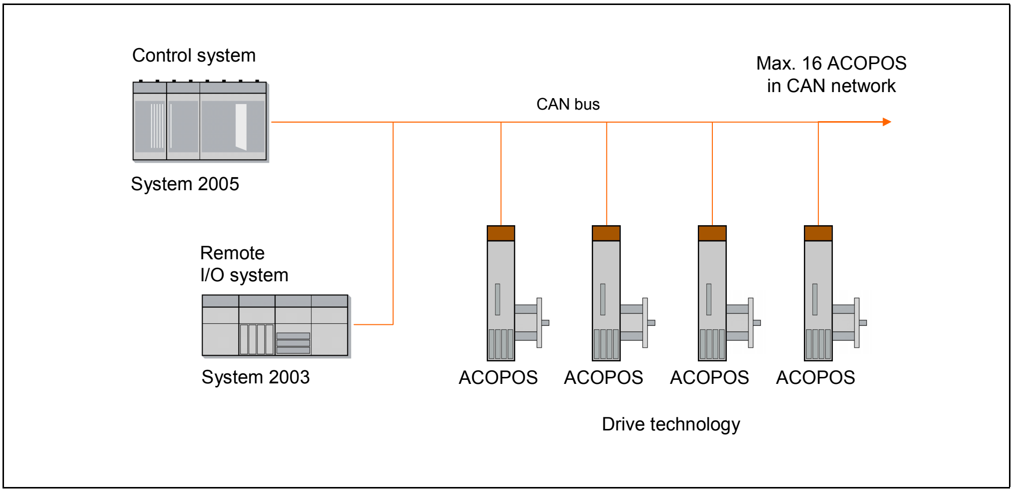

Control system
System 2005
CAN bus
Max. 16 ACOPOS
in CAN network
Remote
I/O system
System 2003
ACOPOS
ACOPOS
ACOPOS
ACOPOS
Drive technology

Figure 9: ACOPOS™ on the CAN bus

2.3.1 Drive-based Automation with ACOPOS™

The controller is located centrally in an ACOPOS™ servo drive. The drives are networked with each other via CAN bus so that multi-axis movements can be synchronized.
Control of the simple operation/visualization is handled by the controller in the ACOPOS™ servo drive. I/O signals are connected in the switching cabinet or directly in the machine room.

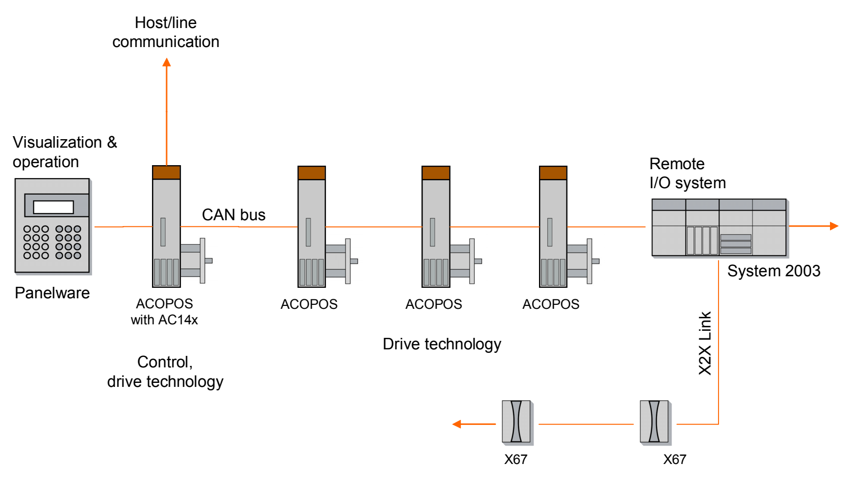

Host/line
communication
Visualization &
operation
Panelware
CAN bus
ACOPOS
with AC14x
ACOPOS
ACOPOS
ACOPOS
Remote
I/O system
System 2003
Control,
drive technology
Drive technology
X2X Link
X67
X67

Figure 10: Drive-based automation with ACOPOS™

3. Safety Guidelines

3.1 General Information

B&R servo drives and servo motors have been designed, developed and manufactured for conventional use in industry. They were not designed, developed and manufactured for any use involving serious risks or hazards that without the implementation of exceptionally stringent safety precautions could lead to death, injury, serious physical damage or loss of any other kind. Such risks include in particular the use of these devices to monitor nuclear reactions in nuclear power plants, as well as flight control systems, flight safety, the control of mass transportation systems, medical life support systems, and the control of weapons systems.

> ### Danger!
>
> **Servo drives and servo motors can have bare parts with voltages applied (e.g. terminals) or hot surfaces. Additional sources of danger result from moving machine parts. Improperly removing the required covers, inappropriate use, incorrect installation or incorrect operation can result in severe personal injury or damage to property.**

All tasks, such as transport, installation, commissioning and service, are only allowed to be carried out by qualified personnel. Qualified personnel are persons familiar with transport, mounting, installation, commissioning and operation of the product and have the respective qualifications (e.g. IEC 60364). National accident prevention guidelines must be followed.

The safety guidelines, connection descriptions (type plate and documentation) and limit values listed in the technical data are to be read carefully before installation and commissioning and must be observed.

> ### Danger!
>
> **Handling servo drives and servo motors incorrectly can cause severe personal injury or damage to property!**

3.2 Intended Use

Servo drives are components designed to be installed in electrical systems or machines. They are not being used as intended unless the machine meets EG regulation 98/37/EG (machine regulation) as well as regulation 89/336/EWG (EMC regulation).

Servo drives are only allowed to be operated directly on grounded, three-phase industrial mains (TN, TT power mains). When using them in living areas, shops and small businesses, additional filtering measures must be implemented by the user.

Danger!

Servo drives are not allowed to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

The technical data as well as the values for connection and environmental specifications can be found on the type plate and in the user's manual. The connection and environmental specifications must be met!

Danger!

Electronic devices are generally not fail-safe. If the servo drive fails, the user is responsible for making sure that the motor is placed in a secure state.

3.3 Transport and Storage

During transport and storage, devices must be protected from excessive stress (mechanical load, temperature, humidity, aggressive atmosphere).

Servo drives contain components sensitive to electrostatic charges which can be damaged by inappropriate handling. It is therefore necessary to provide the required safety precautions against electrostatic discharges during installation or removal of servo drives.

3.4 Installation

The installation must take place according to the user's manual using suitable equipment and tools.

The devices are only allowed to be installed without voltage applied and by qualified personnel. Before installation, voltage to the switching cabinet should be switched off and prevented from being switched on again.

The general safety regulations and national accident prevention guidelines (e.g. VBG 4) must be observed when working with high voltage systems.

The electrical installation must be carried out according to the relevant guidelines (e.g. line cross section, fuse, protective ground connection, also see chapter 4 "Dimensioning").

3.5 Operation

3.5.1 Protection Against Coming into Contact with Electrical Parts

> ## Danger!
>
> **To operate servo drives, it is necessary that certain parts are carrying voltages over 42 VDC. A life-threatening electrical shock could occur if you touch these parts. This could result in death, severe injury or material damage.**

Before turning on a servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

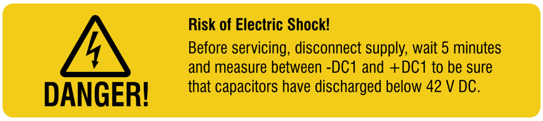
Before turning the device on, make sure that all voltage carrying parts are securely covered. During operation, all covers and switching cabinet doors must remain closed.

Control and high power contacts can have voltage applied, even when the motor is not turning. Touching the contacts when the device is switched on is not permitted.

Before working on servo drives, they must be disconnected from the power mains and prevented from being switched on again.

> ## Danger!
>
> **After switching off the servo drive, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured between -DC1 and +DC1 with a suitable measuring device before beginning work. This voltage must be less than 42 V DC to rule out danger. The Run LED going out does not indicate that voltage is not present on the device!**

The servo drives are labeled with the following warning signs:



Risk of Electric Shock!
Before servicing, disconnect supply, wait 5 minutes and measure between -DC1 and +DC1 to be sure that capacitors have discharged below 42 V DC.

Figure 11: Warning signs on the servo drives

The connections for the signal voltages (5 to 30 V) found on the servo drives are isolated circuits. Therefore, the signal voltage connections and interfaces are only allowed to be connected to devices or electrical components with sufficient isolation according to IEC 60364-4-41 or EN 50178.

Never remove the electrical connections from the servo drive with voltage applied. In unfavorable conditions, arcs can occur causing personal injury and damage to contacts.

3.5.2 Protection from Dangerous Movements

Danger!

Incorrect control of motors can cause unwanted and dangerous movements! Such incorrect behavior can have various causes:

- **Incorrect installation or an error when handling the components**
- **Incorrect or incomplete wiring**
- **Defective devices (servo drive, motor, position encoder, cable, brake)**
- **Incorrect control (e.g. caused by software error)**

Some of these causes can be recognized and prevented by the servo drive using internal monitoring. However, it is generally possible for the motor shaft to move every time the device is switched on! Therefore protection of personnel and the machine can only be guaranteed using higher level safety precautions.

The movement area of machines must be protected to prevent accidental access. This type of protection can be obtained by using stabile mechanical protection such as protective covers, protective fences, protective gates or photocells.

Removing, bridging or bypassing these safety features and entering the movement area is prohibited.

A sufficient number of emergency stop switches are to be installed directly next to the machine. The emergency stop equipment must be checked before commissioning the machine.

Remove shaft keys on free running motors or prevent them from being catapulted.

The holding brake built into the motors cannot prevent hoists from allowing the load to sink.

3.5.3 Protection from Burns

The surfaces of servo drives and servo motors can become very hot during operation.

Therefore, the servo drives are labeled with the following warning:

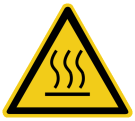


Figure 12: "Hot surface" warning

3.6 Safety Notices

The safety notices in this manual are organized as follows:

Safety notices	Description
Danger!	Disregarding the safety regulations and guidelines can be life-threatening.
Warning!	Disregarding the safety regulations and guidelines can result in severe injury or major damage to material.
Caution!	Disregarding the safety regulations and guidelines can result in injury or damage to material.
Information:	Important information for preventing errors

Table 1: Description of the safety notices used in this manual

Chapter 2 • Technical Data

1. ACOPOS Servo Family

1.1 Modular Servo Drive Concept

Controlling your power transmission system with B&R ACOPOS servo drives allows you to fully use the advantages of an optimized system architecture. In this way, applications that require additional positioning tasks such as torque limitation or torque control can be created quickly and elegantly.

The flexible system concept for B&R servo drives is achieved using matched hardware and software components. You can select the optimal system configuration for your application and increase your competitiveness.

- Perfect integration in the B&R 2000 product family
- Object-oriented axis programming minimizes development time and increases reusability
- Integrated technology functions for branch specific tasks
- Operation of synchronous and asynchronous motors possible
- Current controller scan time up to 50 µs
- Reduced commissioning and service times using "embedded motor parameter chip"
- CAN and Powerlink network connection
- Input voltage range from 400 - 480 VAC (±10 %) for use worldwide
- Connection possibilities for all standard encoder systems
- Up to two free slots for optional technology modules
- Electronic secure restart inhibit integrated

1.2 General Description

The ACOPOS servo drive series covers a current range from 1.0 - 128 A and a power range from 0.5 - 64 kW with 11 devices in 4 groups. The devices in a group are designed using the same basic concept.

Group	8V1010.00-2 8V1010.50-2 8V1016.00-2 8V1016.50-2	8V1022.00-2 8V1045.00-2 8V1090.00-2	8V1180.00-2 8V1320.00-2	8V1640.00-2 8V128M.00-2
Power Connections	Plug connection	Plug connection	Plug connection	Fixed
Integrated Line Filter	Yes	Yes	Yes	Yes
Mains Failure Monitoring	Yes	Yes	Yes	Yes
DC Bus Connection	Yes	Yes	Yes	Yes
24 VDC Supply	External 1)	External 1)	External or internal via DC bus	External or internal via DC bus
24 VDC Output	No	No	24 V / 0.5 A	24 V / 0.5 A
Integrated Brake Chopper	Yes	Yes	Yes	Yes
Internal Braking Resistor	Yes	Yes	Yes	Yes 2)
Connection of External Braking Resistor Possible	No	No	Yes	Yes
Monitored Output for Motor Holding Brake	Yes	Yes	Yes	Yes
Monitored Input for Motor Temperature Sensor	Yes	Yes	Yes	Yes
Max. Number of Plug-in Modules	3	4	4	4

Table 2: General description of the ACOPOS servo drive series

1) External DC bus power supply 0PS320.1 (24V / 20A) can be used.

2) The braking resistor integrated in the ACOPOS servo drives 1640 and 128M is dimensioned so that it is possible to brake to a stop (in a typical drive situation).

The ACOPOS servo drives also provide a modular fieldbus interface in addition to connection possibilities for all standard encoder systems.

ACOPOS servo drives are suitable for both synchronous and asynchronous servo motors and have built-in line filters to meet the limit values for CISPR11, Group 2, Class A.

Warning!

ACOPOS servo drives are suitable for power mains which can provide a maximum short circuit current of 10000 A_{eff} at a maximum of 528 V_{eff}.

1.2.1 24 VDC Supply During Power Failures

In order to be able to provide the stop function for category 1 according to IEC 60204-1 during a power failure, the 24 VDC supply voltage for the servo drives as well as encoders, sensors and the safety circuit must remain active during the entire stopping procedure.

The ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy that occurs when braking is returned to the DC bus and the DC bus power supply can use it to create the 24 VDC supply voltage.

Danger!

In some applications, the DC bus is not ready for operation or there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.

Internal DC bus power supplies are not ready for operation during the ACOPOS servo drive switch-on interval, external DC bus power supplies are not ready for operation while booting.

An external DC bus power supply must be used for ACOPOS servo drives 8V1010 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M.

The ACOPOS servo drives with an integrated DC bus power supply provide the 24 VDC supply for the servo drive and also a 24 VDC output to supply encoders, sensors and the safety circuit. In may cases, it is not necessary to use an uninterruptible power supply (UPS) which is otherwise needed.

1.3 Indications

The ACOPOS servo drives are equipped with three LEDs for direct diagnosis:

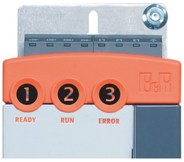
Image	LED	Description	Color
	❶	Ready	Green
	❷	Run	Orange
	❸	Error	Red

Table 3: Status LEDs on ACOPOS servo drives

If no LEDs are lit, the ACOPOS servo drive is not being supplied with 24 VDC.

Danger!

After switching off the device, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured with a suitable measuring device before beginning work. This voltage must be less than 42 VDC to rule out danger. The Run LED going out does not indicate that voltage is not present on the device!

Signal	LED	Description
Ready	Green	Lit when the ACOPOS servo drive is ready for operation and the power level can be enabled (operating system present and booted, no permanent or temporary errors).
Run	Orange	Lit as soon as the power level is enabled for the ACOPOS servo drive.
Error	Red	Lit when a permanent or temporary error exists on the ACOPOS servo drive. After correcting the error, the LED is automatically switched off. Examples of permanent errors: • Motor feedback not connected or defective • Low level on the enable input • Motor temperature sensor not connected or defective • Internal error on the device (e.g. IGBT heat sink temperature sensor defective) Examples of temporary errors: • 24 VDC supply voltage exceeds the tolerance range • DC bus voltage exceeds the tolerance range • Internal 15 VDC control voltage exceeds the tolerance range • IGBT current limit reached • Over-temperature on the motor (temperature sensor) • Over-temperature on the servo drive (IGBT junction, heat sink) • Over-temperature on braking resistor • CAN or Powerlink network faulty

Table 4: LED status

1.3.1 LED Status

The following timing is used for the indication diagrams:

Block size: 125 ms

Repeats after: 3000 ms

Status changes when booting the operating system loader

Status	LED	Display
1. Boot procedure for basic hardware active	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥
2. Configuration of network plug-in module active	Green	🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩🟩
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥
3. Waiting for network telegram	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
4. Network communication active	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	⬜⬜🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥⬜⬜🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥🟥

Table 5: Status changes when booting the operating system loader

Error status with reference to the CAN plug-in module AC110

Status	LED	Display
Boot error on CAN basic hardware	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜
Bus Off	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜⬜⬜⬜
CAN node number is 0	Green	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Orange	⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
	Red	🟥🟥⬜⬜🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥🟥⬜⬜🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜

Table 6: Error status with reference to the CAN plug-in module AC110

Error status with reference to the ETHERNET Powerlink plug-in module AC112

Status	LED	Display																																						
Boot error on Powerlink basic hardware	Green																																							
	Orange																																							
	Red	🟥	🟥			🟥	🟥			🟥	🟥			🟥	🟥											🟥	🟥			🟥	🟥			🟥	🟥			🟥	🟥	
Error when booting the AC112-ARM	Green																																							
	Orange																																							
	Red	🟥	🟥			🟥	🟥			🟥	🟥															🟥	🟥			🟥	🟥			🟥	🟥					
Powerlink node number is 0	Green																																							
	Orange																																							
	Red	🟥	🟥			🟥	🟥																			🟥	🟥			🟥	🟥									

Table 7: Error status with reference to the ETHERNET Powerlink plug-in module AC112

1.4 ACOPOS 1010, 1016

1.4.1 Order Data

Model Number	Short Description	Image
	Servo Drives	ACOPOS 1016 READY RUN SERVO DANGER! AC 110 AC 120
8V1010.00-2	Servo drive 3x400-480V 1.0A 0.45kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1010.50-2	Servo drive 3x110-230V / 1x110-230V 2.0A 0.45kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1016.00-2	Servo drive 3x400-480V 1.6A 0.7kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1016.50-2	Servo drive 3x110-230V / 1x110-230V 3.2A 0.7kW, line filter, braking resistor and electronic secure restart inhibit integrated	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately	
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP Slave interface, 1 RS232 interface, order program memory separately!	
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Ethernet interface, 1 Profibus-DP slave interface, 1 RS232 interface, order application memory separately!	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 8: Order data for ACOPOS 1010, 1016

1.4.2 Technical Data

Product ID	8V1010.00-2	8V1016.00-2	8V1010.50-2	8V1016.50-2
General Information				
C-UL-US Listed	In preparation			
Power Mains Connection				
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)		3 x 110 VAC to 230 VAC ±10 % or 1 x 110 VAC to 230 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)	
Frequency	50 / 60 Hz ± 4%		50 / 60 Hz ± 4%	
Installed Load	Max. 1.35 kVA	Max. 2.1 kVA	Max. 1.35 kVA	Max. 2.1 kVA
Starting Current	2 A (at 400 VAC)		5 A (at 230 VAC)	
Switch-on Interval	> 10 s			
Power Loss at Max. Device Power without Braking Resistor	In preparation	In preparation	In preparation	In preparation
24 VDC Supply				
Input Voltage[1)]	24 VDC +25 % / -20 %			
Input Capacitance	5600 µF			
Current Requirements [2)]	Max. 1.47 A + current for motor holding brake			
DC Bus				
DC Bus Capacitance	165 µF		2040 µF	
Motor Connector				
Continuous Current [3)]	1 A	1.6 A	2 A	3.2 A
Reduction of Continuous Current Depending on Environmental Temperature [4)]				
Mains Input Voltage: 400 VAC				
Switching Frequency 20 kHz	**In preparation**	**In preparation**	**In preparation**	**In preparation**
Switching Frequency 10 kHz	In preparation	In preparation	In preparation	In preparation
Switching Frequency 5 kHz	In preparation	In preparation	In preparation	In preparation
Mains Input Voltage: 480 VAC				
Switching Frequency 20 kHz	**In preparation**	**In preparation**	**In preparation**	**In preparation**
Switching Frequency 10 kHz	In preparation	In preparation	In preparation	In preparation
Switching Frequency 5 kHz	In preparation	In preparation	In preparation	In preparation
Reduction of Continuous Current Depending on Altitude Starting at 500 m Above Sea Level	0.1 A_{eff} per 1000 m	0.16 A_{eff} per 1000 m	0.2 A_{eff} per 1000 m	0.32 A_{eff} per 1000 m
Peak Current	2.8 A_{eff}	5 A_{eff}	7.8 A_{eff}	12 A_{eff}
Nominal Switching Frequency	20 kHz			
Maximum Motor Line Length	25 m			
Protective Measures	Short circuit and ground fault protection			
Motor Holding Brake Connection				
Maximum Output Current	1.3 A			
Protective Measures	Short circuit and ground fault protection			

Table 9: Technical data for ACOPOS 1010, 1016

Product ID	**8V1010.00-2**	**8V1016.00-2**	**8V1010.50-2**	**8V1016.50-2**
Braking Resistor				
Peak Power Output	2 kW			
Continuous Power Output	In preparation			
Trigger Inputs				
Number of Inputs	2			
Wiring	Sink			
Electrical Isolation Input - ACOPOS Input - Input	 Yes No			
Input Voltage Nominal Maximum	 24 VDC 30 VDC			
Switching Threshold LOW HIGH	 <5 V >15 V			
Input Current at Nominal Voltage	Approx. 10 mA			
Switching Delay	Max. 55 µs (digitally filtered)			
Modulation Compared to Ground Potential	Max. ±38 V			
Limit Switch and Reference Inputs				
Number of Inputs	3			
Wiring	Sink			
Electrical Isolation Input - ACOPOS Input - Input	 Yes No			
Input Voltage Nominal Maximum	 24 VDC 30 VDC			
Switching Threshold LOW HIGH	 <5 V >15 V			
Input Current at Nominal Voltage	Approx. 4 mA			
Switching Delay	Max. 2.0 ms			
Modulation Compared to Ground Potential	Max. ±38 V			
Enable Input				
Number of Inputs	1			
Wiring	Sink			
Electrical Isolation Input - ACOPOS	 Yes			
Input Voltage Nominal Maximum	 24 VDC 30 VDC			
Switching Threshold LOW HIGH	 <5 V >15 V			
Input Current at Nominal Voltage	Approx. 30 mA			

Table 9: Technical data for ACOPOS 1010, 1016 (Forts.)

Product ID	**8V1010.00-2**	**8V1016.00-2**	**8V1010.50-2**	**8V1016.50-2**
Switching Delay Enable 1 -> 0, PWM Off Enable 0 -> 1, Ready for PWM	 Max. 2.0 ms Max. 100 µs			
Modulation Compared to Ground Potential	Max. ±38 V			
Operational Conditions				
Environmental Temperature During Operation Max. Environmental Temperature 5)	0 to 50° C +55 °C			
Relative Humidity During Operation	5 to 95%, non-condensing			
Installation at Altitudes Above Sea Level Maximum Installation Altitude 6)	0 to 500 m 2000 m			
Degree of Pollution According to IEC 60664-1	2 (non-conductive material)			
Over-voltage Category According to IEC 60364-4-443:1999	II			
Protection According to IEC 60529	IP20			
Storage and Transport Conditions				
Storage Temperature	-25 to +55 °C			
Relative Humidity During Storage	5 to 95%, non-condensing			
Transport Temperature	-25 to +70° C			
Relative Humidity During Transport	95 % at +40 °C			
Mechanical Characteristics				
Dimensions Width Height Depth	 58.5 mm 257 mm 220 mm			
Weight	2.5 kg	2.5 kg	2.5 kg	2.5 kg

Table 9: Technical data for ACOPOS 1010, 1016 (Forts.)

1) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.

2) The current requirements depend on the configuration of the ACOPOS servo drive.

3) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C environmental temperature, installation altitudes < 500 m above sea level.

4) The nominal switching frequency values for the respective ACOPOS servo drive are marked in bold.

5) Continuous operation of ACOPOS servo drives at environmental temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.

6) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Additional requirements are to be arranged with B&R.

1.5 ACOPOS 1022, 1045, 1090

1.5.1 Order Data

Model Number	Short Description	Image
	Servo Drives	ACOPOS 1045
8V1022.00-2	Servo drive 3 x 400-480V 2.2A 1kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1045.00-2	Servo drive 3 x 400-480V 4.4A 2kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1090.00-2	Servo drive 3 x 400-480V 8.8A 4kW, line filter, braking resistor and electronic secure restart inhibit integrated	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately	
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP Slave interface, 1 RS232 interface, order program memory separately!	
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, order application memory separately!	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 10: Order data for ACOPOS 1022, 1045, 1090

1.5.2 Technical Data

Product ID	**8V1022.00-2**	**8V1045.00-2**	**8V1090.00-2**
General Information			
C-UL-US Listed	Yes		
Power Mains Connection			
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)		
Frequency	50 / 60 Hz ± 4%		
Installed Load	Max. 3 kVA	Max. 5 kVA	Max. 10 kVA
Starting Current at 400 VAC	4 A	7 A	7 A
Switch-on Interval	> 10 s		
Power Loss at Max. Device Power without Braking Resistor	Approx. 120 W	Approx. 180 W	Approx. 200 W
24 VDC Supply			
Input Voltage 1)	24 VDC +25 % / -25 %		
Input Capacitance	8200 µF		
Current Requirements 2)	Max. 2.5 A + current for motor holding brake		
DC Bus			
DC Bus Capacitance	235 µF		470 µF
Motor Connector			
Continuous Current 3)	2.2 A_{eff}	4.4 A_{eff}	8.8 A_{eff}
Reduction of Continuous Current Depending on Environmental Temperature 4)			
Mains Input Voltage: 400 VAC			
Switching Frequency 20 kHz	**No reduction**	**0.13 A_{eff} per °C (≥ 45 °C)**	0.18 A_{eff} per °C (≥ 30 °C)
Switching Frequency 10 kHz	No reduction	No reduction	**0.18 A_{eff} per °C (≥ 54 °C)**
Switching Frequency 5 kHz	No reduction	No reduction	No reduction
Mains Input Voltage: 480 VAC			
Switching Frequency 20 kHz	**0.13 A_{eff} per °C (≥ 51 °C)**	**0.13 A_{eff} per °C (≥ 35 °C)**	0.18 A_{eff} per °C (≥ 18 °C)
Switching Frequency 10 kHz	No reduction	No reduction	**0.18 A_{eff} per °C (≥ 48 °C)**
Switching Frequency 5 kHz	No reduction	No reduction	No reduction
Reduction of Continuous Current Depending on Altitude Starting at 500 m Above Sea Level	0.22 A_{eff} per 1000 m	0.44 A_{eff} per 1000 m	0.88 A_{eff} per 1000 m
Peak Current	14 A_{eff}	24 A_{eff}	24 A_{eff}
Nominal Switching Frequency	20 kHz		10 kHz
Maximum Motor Line Length	25 m		
Protective Measures	Short circuit and ground fault protection		
Motor Holding Brake Connection			
Maximum Output Current	1 A		
Protective Measures	Short circuit and ground fault protection		

Table 11: Technical data for ACOPOS 1022, 1045, 1090

Product ID	8V1022.00-2	8V1045.00-2	8V1090.00-2
Braking Resistor			
Peak Power Output	3.5 kW	7 kW	7 kW
Continuous Power Output	130 W	200 W	200 W
Trigger Inputs			
Number of Inputs	2		
Wiring	Sink		
Electrical Isolation Input - ACOPOS Input - Input	 Yes No		
Input Voltage Nominal Maximum	 24 VDC 30 VDC		
Switching Threshold LOW HIGH	 < 5 V >15 V		
Input Current at Nominal Voltage	Approx. 10 mA		
Switching Delay	Max. 55 µs (digitally filtered)		
Modulation Compared to Ground Potential	Max. ±38 V		
Limit Switch and Reference Inputs			
Number of Inputs	3		
Wiring	Sink		
Electrical Isolation Input - ACOPOS Input - Input	 Yes No		
Input Voltage Nominal Maximum	 24 VDC 30 VDC		
Switching Threshold LOW HIGH	 < 5 V >15 V		
Input Current at Nominal Voltage	Approx. 4 mA		
Switching Delay	Max. 2.0 ms		
Modulation Compared to Ground Potential	Max. ±38 V		
Enable Input			
Number of Inputs	1		
Wiring	Sink		
Electrical Isolation Input - ACOPOS	 Yes		
Input Voltage Nominal Maximum	 24 VDC 30 VDC		
Switching Threshold LOW HIGH	 < 5 V >15 V		
Input Current at Nominal Voltage	Approx. 30 mA		

Table 11: Technical data for ACOPOS 1022, 1045, 1090 (Forts.)

Product ID	**8V1022.00-2**	**8V1045.00-2**	**8V1090.00-2**
Switching Delay Enable 1 -> 0, PWM Off Enable 0 -> 1, Ready for PWM	 Max. 2.0 ms Max. 100 µs		
Modulation Compared to Ground Potential	Max. ±38 V		
Operational Conditions			
Environmental Temperature During Operation Max. Environmental Temperature 5)	0 to 50° C +55 °C		
Relative Humidity During Operation	5 to 95%, non-condensing		
Installation at Altitudes Above Sea Level Maximum Installation Altitude 6)	0 to 500 m 2000 m		
Degree of Pollution According to IEC 60664-1	2 (non-conductive material)		
Over-voltage Category According to IEC 60364-4-443:1999	II		
Protection According to IEC 60529	IP20		
Storage and Transport Conditions			
Storage Temperature	-25 to +55 °C		
Relative Humidity During Storage	5 to 95%, non-condensing		
Transport Temperature	-25 to +70° C		
Relative Humidity During Transport	95 % at +40 °C		
Mechanical Characteristics			
Dimensions Width Height Depth	 70.5 mm 375 mm 235.5 mm		
Weight	4.0 kg	4.1 kg	4.4 kg

Table 11: Technical data for ACOPOS 1022, 1045, 1090 (Forts.)

1) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.

2) The current requirements depend on the configuration of the ACOPOS servo drive.

3) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C environmental temperature, installation altitudes < 500 m above sea level.

4) The nominal switching frequency values for the respective ACOPOS servo drive are marked in bold.

5) Continuous operation of ACOPOS servo drives at environmental temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.

6) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Additional requirements are to be arranged with B&R.

1.6 ACOPOS 1180, 1320

1.6.1 Order Data

Model Number	Short Description	Image
	Servo Drives	
8V1180.00-2	Servo drive 3 x 400-480V 18A 9kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
8V1320.00-2	Servo drive 3 x 400-480V 32A 16kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately	
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order program memory separately!	
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 12: Order data for ACOPOS 1180, 1320

1.6.2 Technical Data

Product ID	**8V1180.00-2**	**8V1320.00-2**
General Information		
C-UL-US Listed	Yes	
Power Mains Connection		
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)	
Frequency	50 / 60 Hz ± 4%	
Installed Load	Max. 17 kVA	Max. 30 kVA
Starting Current at 400 VAC	13 A	
Switch-on Interval	> 10 s	
Power Loss at Max. Device Power without Braking Resistor	Approx. 500 W	Approx. 800 W
24 VDC Supply		
Input Voltage	24 VDC ± 25 % / -20 %	
Input Capacitance	40000 µF	
Current Requirements at 24 VDC 1) Mains Input Voltage Applied Mains Input Voltage not Applied	 --- 2) Max. 2.8 A + current for the motor holding brake + current on the 24 VDC output	
DC Bus Power Supply Switch-on Voltage	 400 VDC	
DC Bus		
DC Bus Capacitance	940 µF	1645 µF
Motor Connector		
Continuous Current 3)	19 A_{eff}	34 A_{eff}
Reduction of Continuous Current Depending on Environmental Temperature 4) Mains Input Voltage: 400 VAC Switching Frequency 20 kHz Switching Frequency 10 kHz Switching Frequency 5 kHz Mains Input Voltage: 480 VAC Switching Frequency 20 kHz Switching Frequency 10 kHz Switching Frequency 5 kHz	 No reduction **No reduction** No reduction No reduction **No reduction** No reduction	 0.61 A_{eff} per °C (≥ 40 °C) **No reduction** No reduction 0.61 A_{eff} per °C (≥ 25 °C) **No reduction** No reduction
Reduction of Continuous Current Depending on Altitude Starting at 500 m Above Sea Level	 1.9 A_{eff} per 1000 m	 3.4 A_{eff} per 1000 m
Peak Current	50 A_{eff}	80 A_{eff}
Nominal Switching Frequency	10 kHz	
Maximum Motor Line Length	25 m	
Protective Measures	Short circuit and ground fault protection	

Table 13: Technical data for ACOPOS 1180, 1320

Product ID	8V1180.00-2	8V1320.00-2
Motor Holding Brake Connection		
Maximum Output Current	1.5 A	
Protective Measures	Short circuit and ground fault protection	
Braking Resistor		
Peak Power Int. / Ext.	14 / 40 kW	
Continuous Power Int. / Ext.	0.4 / 8 kW	
Minimum Braking Resistance (ext.)	15 Ω	
Rated Current of the Built-in Fuse	10 A (fast-acting)	
Trigger Inputs		
Number of Inputs	2	
Wiring	Sink	
Electrical Isolation Input - ACOPOS Input - Input	 Yes No	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 10 mA	
Switching Delay	Max. 55 µs (digitally filtered)	
Modulation Compared to Ground Potential	Max. ±38 V	
Limit Switch and Reference Inputs		
Number of Inputs	3	
Wiring	Sink	
Electrical Isolation Input - ACOPOS Input - Input	 Yes No	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 4 mA	
Switching Delay	Max. 2.0 ms	
Modulation Compared to Ground Potential	Max. ±38 V	
Enable Input		
Number of Inputs	1	
Wiring	Sink	
Electrical Isolation Input - ACOPOS	 Yes	

Table 13: Technical data for ACOPOS 1180, 1320 (Forts.)

Product ID	8V1180.00-2	8V1320.00-2
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 30 mA	
Switching Delay Enable 1 -> 0, PWM Off Enable 0 -> 1, Ready for PWM	 Max. 2.0 ms Max. 100 µs	
Modulation Compared to Ground Potential	Max. ±38 V	
Operational Conditions		
Environmental Temperature During Operation Max. Environmental Temperature 5)	0 to 50° C +55 °C	
Relative Humidity During Operation	5 to 95%, non-condensing	
Installation at Altitudes Above Sea Level Maximum Installation Altitude 6)	0 to 500 m 2000 m	
Degree of Pollution According to IEC 60664-1	2 (non-conductive material)	
Over-voltage Category According to IEC 60364-4-443:1999	II	
Protection According to IEC 60529	IP20	
Storage and Transport Conditions		
Storage Temperature	-25 to +55 °C	
Relative Humidity During Storage	5 to 95%, non-condensing	
Transport Temperature	-25 to +70° C	
Relative Humidity During Transport	95 % at +40 °C	
Mechanical Characteristics		
Dimensions Width Height Depth	 200 mm 375 mm 234 mm	
Weight	10.1 kg	10.6 kg

Table 13: Technical data for ACOPOS 1180, 1320 (Forts.)

1) The current requirements depend on the configuration of the ACOPOS servo drive.
2) The 24 VDC supply voltage for the ACOPOS servo drive is created by the integrated DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0. Mains Input Voltage: 3 x 400 VAC to 480 VAC ± 10 %.
3) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C environmental temperature, installation altitudes < 500 m above sea level.
4) The nominal switching frequency values for the respective ACOPOS servo drive are marked in bold.
5) Continuous operation of ACOPOS servo drives at environmental temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.
6) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Additional requirements are to be arranged with B&R.

1.7 ACOPOS 1640, 128M

1.7.1 Order Data

Model Number	Short Description	Image
	Servo Drives	ACOPOS 1640 U V W -DC1 -DC2 +DC1 +DC2 L1 L2 L3
8V1640.00-2	Servo drive 3 x 400-480V 64A 32kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated [1]	
8V128M.00-2	Servo drive 3 x 400-480V 128A 64kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated [1]	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately	
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order program memory separately!	
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 14: Order data for ACOPOS 1640, 128M

1) Integrated line filter in preparation.

1.7.2 Technical Data

Product ID	**8V1640.00-2**	**8V128M.00-2**
General Information		
C-UL-US Listed	Yes	
Power Mains Connection		
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)	
Frequency	50 / 60 Hz ± 4%	
Installed Load	Max. 54 kVA	Max. 98 kVA
Starting Current at 400 VAC	26 A	
Switch-on Interval	> 10 s	
Power Loss at Max. Device Power without Braking Resistor	Approx. 1600 W	Approx. 3200 W
24 VDC Supply		
Input Voltage	24 VDC +25 % / -20 %	
Input Capacitance	32800 µF	
Current Requirements at 24 VDC 1)		
Mains Input Voltage Applied	--- 2)	--- 2)
Mains Input Voltage not Applied	Max. 4.6 A + 1.4 * (current for the motor holding brake + current on the 24 VDC output)	Max. 5.7 A + 1.4 * (current for the motor holding brake + current on the 24 VDC output)
DC Bus Power Supply		
Switch-on Voltage	400 VDC	
DC Bus		
DC Bus Capacitance	3300 µF	6600 µF
Motor Connector		
Continuous Current 3)	64 A_{eff}	128 A_{eff}
Reduction of Continuous Current Depending on Environmental Temperature 4)		
Mains Input Voltage: 400 VAC		
Switching Frequency 20 kHz	0.96 A_{eff} per °C (≥ 25 °C)	In preparation
Switching Frequency 10 kHz	**No reduction**	In preparation
Switching Frequency 5 kHz	No reduction	**In preparation**
Mains Input Voltage: 480 VAC		
Switching Frequency 20 kHz	0.96 A_{eff} per °C (≥ 10 °C)	In preparation
Switching Frequency 10 kHz	**0.96 A_{eff} per °C (≥ 50 °C)**	In preparation
Switching Frequency 5 kHz	No reduction	**In preparation**
Reduction of Continuous Current Depending on Altitude		
Starting at 500 m Above Sea Level	6.4 A_{eff} per 1000 m	12.8 A_{eff} per 1000 m
Peak Current	200 A_{eff}	300 A_{eff}
Nominal Switching Frequency	10 kHz	5 kHz
Maximum Motor Line Length	25 m	
Protective Measures	Short circuit and ground fault protection	

Table 15: Technical data for ACOPOS 1640, 128M

Product ID	8V1640.00-2	8V128M.00-2
Motor Holding Brake Connection		
Maximum Output Current	3 A	
Protective Measures	Short circuit and ground fault protection	
Braking Resistor		
Peak Power Int. / Ext.	7 / 250 kW	8.5 / 250 kW
Continuous Power Int. / Ext.	0.2 / 24 kW	0.24 / 24 kW
Minimum Braking Resistance (ext.)	2,5 Ω	
Rated Current of the Built-in Fuse	30 A (fast-acting)	
Trigger Inputs		
Number of Inputs	2	
Wiring	Sink	
Electrical Isolation Input - ACOPOS Input - Input	 Yes No	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 10 mA	
Switching Delay	Max. 55 µs (digitally filtered)	
Modulation Compared to Ground Potential	Max. ±38 V	
Limit Switch and Reference Inputs		
Number of Inputs	3	
Wiring	Sink	
Electrical Isolation Input - ACOPOS Input - Input	 Yes No	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 4 mA	
Switching Delay	Max. 2.0 ms	
Modulation Compared to Ground Potential	Max. ±38 V	
Enable input		
Number of Inputs	1	
Wiring	Sink	
Electrical Isolation Input - ACOPOS	 Yes	

Table 15: Technical data for ACOPOS 1640, 128M (Forts.)

Product ID	8V1640.00-2	8V128M.00-2
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 < 5 V >15 V	
Input Current at Nominal Voltage	Approx. 30 mA	
Switching Delay Enable 1 -> 0, PWM Off Enable 0 -> 1, Ready for PWM	 Max. 2.0 ms Max. 100 µs	
Modulation Compared to Ground Potential	Max. ±38 V	
Operational Conditions		
Environmental Temperature During Operation Max. Environmental Temperature [5]	0 to 50° C +55 °C	
Relative Humidity During Operation	5 to 95%, non-condensing	
Installation at Altitudes Above Sea Level Maximum Installation Altitude [6]	0 to 500 m 2000 m	
Degree of Pollution According to IEC 60664-1	2 (non-conductive material)	
Over-voltage Category According to IEC 60364-4-443:1999	II	
Protection according to IEC 60529	IP20	
Storage and Transport Conditions		
Storage Temperature	-25 to +55 °C	
Relative Humidity During Storage	5 to 95%, non-condensing	
Transport Temperature	-25 to +70° C	
Relative Humidity During Transport	95 % at +40 °C	
Mechanical Characteristics		
Dimensions Width Height Depth	 276 mm 460 mm 295 mm	 402 mm 460 mm 295 mm
Weight	24.1 kg	33.8 kg

Table 15: Technical data for ACOPOS 1640, 128M (Forts.)

1) The current requirements depend on the configuration of the ACOPOS servo drive.
2) The 24 VDC supply voltage for the ACOPOS servo drive is created by the integrated DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0. Mains Input Voltage: 3 x 400 VAC to 480 VAC ± 10 %.
3) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C environmental temperature, installation altitudes < 500 m above sea level.
4) The nominal switching frequency values for the respective ACOPOS servo drive are marked in bold.
5) Continuous operation of ACOPOS servo drives at environmental temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.
6) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Additional requirements are to be arranged with B&R.

2. ACOPOS Plug-in Modules

2.1 General Information

The ACOPOS drives are equipped with up to four plug-in module slots depending on the size.

	8V1010.00-2 8V1010.50-2 8V1016.00-2 8V1016.50-2	8V1022.00-2 8V1045.00-2 8V1090.00-2	8V1180.00-2 8V1320.00-2	8V1640.00-2 8V128M.00-2
Max. Number of Plug-in Modules	3	4		

Table 16: The maximum number of plug-in modules depends on the size of the servo drive

You can select the plug-in modules required for your application and insert them into the ACOPOS servo drive.

2.2 Overview

Model Number	Short Description
8AC110.60-2	ACOPOS plug-in module, CAN interface
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface
8AC122.60-2	ACOPOS plug-in module, resolver interface
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!

Table 17: Overview of ACOPOS plug-in modules

2.3 AC110 - CAN Interface

2.3.1 General Description

The AC110 plug-in module can be used in an ACOPOS slot. The module is equipped with a CAN interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for standard applications.

2.3.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
	Accessories	
7AC911.9	Bus connector, CAN	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm connection cable	

Table 18: Order data for AC110

2.3.3 Technical Data

Product ID	8AC110.60-2
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slot 1
Power Consumption	Max. 0.7 W
CAN Interface	
Connection, Module Side	9-pin DSUB plug
Indication	RXD/TXD LEDs
Electrical Isolation CAN - ACOPOS	Yes

Table 19: Technical data for AC110

Product ID	8AC110.60-2
Maximum Distance	60 m
Baud Rate	500 kBit/s
Network Capable	Yes
Bus Termination Resistor	Externally wired
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 19: Technical data for AC110 (Forts.)

2.3.4 CAN Node Number Settings

The CAN node number can be set using two HEX code switches:

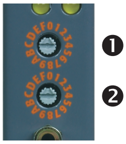
Image	Code switch	CAN Node Number
	❶	16s position (high)
	❷	1s position (low)
	Changing the node number using software is not possible (Basis CAN ID can be changed). The ACOPOS Manager only supports node numbers from 1 - 32. When using the NC157 positioning module, only node numbers from 1 - 8 are possible.	

Table 20: Setting the CAN node number

The CAN node number change takes effect the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

2.3.5 Indications

The status LEDs show if data is being received (RXD) or sent (TXD).

2.3.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.4 AC112 - ETHERNET Powerlink Interface

2.4.1 General Description

The AC112 plug-in module can be used in an ACOPOS slot. The module is equipped with an ETHERNET Powerlink interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for complex and time critical applications.

The plug-in module is set up as a 2x hub. This makes it easy to establish a device to device connection (line topology).

2.4.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	AC 112 STATUS
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	

Table 21: Order data for AC112

2.4.3 Technical Data

Product ID	8AC112.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slot 1
Power Consumption	Max. 2.5 W

Table 22: Technical data for AC112

Product ID	**8AC112.60-1**
Powerlink Interface	
Connection, Module Side	2 x RJ45 socket
Indications	Status LEDs
Electrical Isolation ETHERNET - ACOPOS	 Yes
Maximum Distance per Segment	100 m 1)
Baud Rate	100 Mbit/s
Network Capable	Yes
Hub, 2x	Yes
Maximum Number of Hub Levels	10; see section 2 "ACOPOS™ Configurations" on Page 22
Cabling Topology	Star or tree with level 2 hubs
Possible Station Operating Modes	Synchronous to Powerlink cycle
Watchdog Function Hardware Software	 Yes (via ACOPOS servo drive) Yes (via ACOPOS servo drive)
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 22: Technical data for AC112 (Forts.)

1) With a cycle time of 400 µs and 10 ACOPOS servo drives, the maximum total cable length is 200 m.

2.4.4 Powerlink Station Number Settings

The Powerlink station number can be set using two HEX code switches:

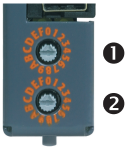
<table>
<tr><th>Image</th><th>Code switch</th><th>Powerlink station number</th></tr>
<tr><td rowspan="3">
</td><td>❶</td><td>16s position (high)</td></tr>
<tr><td>❷</td><td>1s position (low)</td></tr>
<tr><td colspan="2">The Powerlink station number change takes effect the next time the ACOPOS servo drive is switched on.
Information:
In principle, station numbers between $01 and $FD are permitted.
However, station numbers between $F0 and $FD are reserved for future system expansions. For reasons of compatibility, we recommend avoiding these station numbers.
Station numbers $00, $FE and $FF are reserved and are therefore not allowed to be set.</td></tr>
</table>

Table 23: Setting the Powerlink station number

2.4.5 Indications

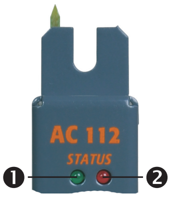


Figure 13: Status LEDs AC112

The status is indicated on the AC112 using one green (❶) and one red LED (❷).

LED Test

Immediately after resetting the module, both LEDs are switched off for 0.5 s, then switched on for 1.5 s.

Then the green LED is cleared for one second and the following boot procedure. After proper initialization, the red LED is switched off and the green LED is switched on.

Status of the LEDs

The following timing is used for the indication diagram:

Block size: 150 ms

Status	LED	Display
Error-free operation	Green	🟩🟩
	Red	⬜⬜
Fatal system error [1]	Green	⬜⬜
	Red	🟥🟥
Master has dropped out	Green	⬜🟩
	Red	🟥⬜
System stop [2]	Green	⬜⬜
	Red	See System Stop Error Codes

Table 24: Indication diagram for the AC112 status LEDs

1) This is a problem which cannot be repaired, the system can no longer carry out tasks correctly.
This status can only be changed by resetting the module.

2) The red LED blinks an error code, the output of the error code occurs in 4 short (150 ms) or long (600 ms) phases.

System stop error codes

The following timing is used for the indication diagram:

Block size: 150 ms

Pause: 2000 ms

Error	Display
Stack overflow	🟥⬜🟥⬜🟥⬜🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥⬜🟥⬜🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜
RAM error	🟥⬜🟥⬜🟥⬜🟥🟥🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥⬜🟥⬜🟥🟥🟥🟥⬜⬜⬜⬜⬜⬜
Undefined address [1]	🟥⬜🟥⬜🟥🟥🟥🟥⬜🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥⬜🟥🟥🟥🟥⬜🟥⬜⬜⬜⬜⬜⬜
Instruction fetch memory abort [2]	🟥⬜🟥⬜🟥🟥🟥🟥⬜🟥🟥🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥⬜🟥🟥🟥🟥⬜🟥🟥🟥🟥
Data access memory abort [3]	🟥⬜🟥🟥🟥🟥⬜🟥⬜🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥🟥🟥🟥⬜🟥⬜🟥⬜⬜⬜⬜⬜⬜
Assertion failed [4]	🟥⬜🟥🟥🟥🟥⬜🟥⬜🟥🟥🟥🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥🟥🟥🟥⬜🟥⬜🟥🟥🟥🟥
Programming failed [5]	🟥⬜🟥🟥🟥🟥⬜🟥🟥🟥🟥⬜🟥⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜🟥⬜🟥🟥🟥🟥⬜🟥🟥🟥🟥⬜🟥

Table 25: System stop error codes

1) Access of non-existent address.
2) Invalid memory access during instruction fetch (e. g. WORD access of add numbered address).
3) Invalid memory access during data access (e. g. WORD access of add numbered address).
4) This system stop code only occurs in debug mode. The condition for a software assertion was not fulfilled.
5) Error during programming.

2.4.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.5 AC120 - EnDat Encoder Interface

2.5.1 General Description

The AC120 plug-in module can be used in an ACOPOS slot. The module has an EnDat encoder interface, but can also be used to evaluate simple incremental encoders with sine formed output signal [1)].

This module can be used to evaluate encoders which are built into B&R servo motors and also encoders for external axes (encoders that evaluate any machine movement). The input signals are monitored. In this way, broken connections, shorted lines and encoder supply failure can be recognized.

EnDat encoder:

EnDat is a standard developed by Johannes Heidenhain GmbH (www.heidenhain.de), incorporating the advantages of absolute and incremental position measurement and also offers a read/write parameter memory in the encoder. With absolute position measurement (absolute position is read in serially), the homing procedure is usually not required. When necessary, a multi-turn encoder (4096 revolutions) should be installed. To save costs, a single-turn encoder and a reference switch can also be used. In this case, a homing procedure must be carried out.

The incremental process allows the short delay times necessary for position measurement on drives with exceptional dynamic properties. With the sinusoidal incremental signal and the fine resolution in the EnDat module, a very high positioning resolution is achieved in spite of the moderate signal frequencies used.

The parameter memory in the EnDat encoder is used by B&R to store motor data (among other things). In this way, the ACOPOS servo drives are always automatically provided the correct motor parameters and limit values. This is referred to as the "embedded parameter chip".

During start-up, the module is automatically identified, configured and its parameters set by the ACOPOS servo drive operating system.

Incremental encoder with sine formed output signal:

When using the AC120 plug-in module to evaluate simple incremental encoders with sine formed output signal, only the incremental transfer channel is now used. The "embedded parameter chip" it not available in this case because this encoder does not have parameter memory. The absolute position is also not available immediately after switching the device on. In this situation, a homing procedure normally has to be carried out. The module is equipped with a reference pulse input for this purpose.

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1) Starting with revision F0.

2.5.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
	Accessories	
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat cable, length 7m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat cable, length 10m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat cable, length 15m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat cable, length 20m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat cable, length 25m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 26: Order data for AC120

2.5.3 Technical Data

Product ID	8AC120.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot 1)	Slots 2, 3 and 4
Power Consumption E0 ... EnDat Single-turn, 512 Lines E1 ... EnDat Multi-turn, 512 Lines E2 ... EnDat Single-turn, 32 Lines (inductive) E3 ... EnDat Multi-turn, 32 Lines (inductive) E4 ... EnDat Single-turn, 512 Lines E5 ... EnDat Multi-turn, 512 Lines	 Max. 2.3 W Max. 3.1 W Max. 3.1 W Max. 3.1 W Max. 2.4 W Max. 2.7 W
Encoder Input 2)	
Connection, Module Side	15-pin DSUB socket
Indications	UP/DN LEDs
Electrical Isolation Encoder - ACOPOS	 No
Encoder Monitoring	Yes

Table 27: Technical data for AC120

Product ID	8AC120.60-1
Encoder Supply Output Voltage Current Handling Capacity Sense Lines	 Typ. 5 V 200 mA 2, compensation of max. 2 x 0.7 V
Sine-Cosine Inputs Signal Transfer Differential Voltage Common Mode Voltage Terminating Resistance Signal Frequency Resolution [3] Precision [4]	 Differential signals, symmetric 0.5 ... 1.25 V_{ss} Max. ±7 V 120 Ω DC ... 400 kHz 16384 * number of encoder lines ---
Reference Input Signal Transfer Differential Voltage for High Differential Voltage for Low Common Mode Voltage Terminating Resistance	 Differential signal, symmetric ≥ +0.2 V ≤ -0.2 V Max. ±7 V 120 Ω
Serial Interface Signal Transfer Baud Rate	Synchronous RS485 625 kBaud
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 27: Technical data for AC120 (Forts.)

1) The AC120 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) The EnDat encoder must be wired using a cable with a single shield.
3) Noise on the encoder signal reduces the resolution that can be used by approx. 4 bits (factor of 16).
4) The precision is actually limited by the encoder.

2.5.4 Indications

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.
DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.5.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.6 AC122 - Resolver Interface

2.6.1 General Description

The AC122 plug-in module can be used in an ACOPOS slot. The module is equipped with a resolver interface.

The plug-in module handles the output from resolvers which are built into B&R servo motors or used as an encoder for external axes. This resolver delivers the absolute position over one revolution. Normally, the movement path is longer than one revolution. In this case, a reference switch must be used and a homing procedure carried out.

The encoder input signals are monitored. In this way, broken connections, shorted lines and encoder supply failure (reference signal) can be recognized.

During start-up, the AC122 module is automatically identified by the ACOPOS operating system. Making automatic adjustments to the motor (resolution parameter) and reading the motor parameters and limit values is not possible because the resolver does not have parameter memory like the EnDat encoder.

If the precision, resolution, bandwidth or ease of setting parameters is not sufficient with the resolver, the EnDat system should be used (see section 2.5 "AC120 - EnDat Encoder Interface" on page 62).

2.6.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
	Accessories	
8CR005.12-1	Resolver cable, length 5m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 28: Order data for AC122

2.6.3 Technical Data

Product ID	**8AC122.60-2**
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot 1)	Slots 2, 3 and 4
Power Consumption	Max. 1.2 W
Resolver Input 2)	
Resolver Type Number of Poles Nominal Voltage Ratio Input Frequency Input Voltage Max. Phase Shift Max. Elec. Angular Error	BRX 3) 2 pin 0,5 ± 5 % 10 kHz 3 to 7 V_{rms} ± 3° ± 10 angular minutes
Connection, Module Side	9-pin DSUB socket
Indications	UP/DN LEDs
Electrical Isolation Resolver - ACOPOS	 No
Encoder Monitoring	Yes
Resolution	Depends on the maximum speed 14 bits/rev for n < 3900 min^{-1} 12 bits/rev for n < 15600 min^{-1}
Bandwidth	1.7 kHz for n < 3900 min^{-1} 2.5 kHz for n < 15600 min^{-1}
Precision	± 8 angular minutes
Reference Output Signal Transfer Differential Voltage Output Current Frequency	 Differential signals Typ. 3.4 V_{eff} Max. 50 mA_{eff} 10 kHz
Sine-Cosine Inputs Signal Transfer Input Impedance at 10 kHz (per pin) Electrical Isolation Encoder-ACOPOS	 Differential signals 10.4 kΩ - j 11.1 kΩ No, common-mode voltage on the sine cosine inputs max ± 20 V
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing

Table 29: Technical data for AC122

Product ID	**8AC122.60-2**
Storage and transport conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 29: Technical data for AC122 (Forts.)

1) The AC122 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) The resolver must be wired using a cable with a single shield and twisted pair signal lines.
3) BRX resolvers are fed with a sine signal (reference signal) from the module and provide two sine signals with a 90° phase shift as a result. The amplitudes of these signals change with the angular position of the resolver.
   Unlike BRX resolvers, BRT resolvers can be fed with two sine signals which are offset by 90°. A single sine signal with constant amplitude is returned. The phase position of this signal changes with the angular position of the resolver.

2.6.4 Indications

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.
DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.6.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.7 AC123 - Incremental Encoder and SSI Absolute Encoder Interface

2.7.1 General Description

The ACOPOS plug-in module AC123 is used to connect standard industrial incremental or absolute encoders with a synchronous serial interface (SSI) to ACOPOS servo drives. For example, this allows electronic gears to be configured which read master movements using external encoders. If the encoder resolution is high enough, motor feedback for asynchronous motors is also possible.

With incremental encoders, the maximum counter frequency is 200 kHz. Single and multi-turn encoders with a maximum of 31 bits at 200 kBaud can be read as absolute SSI encoders.

The position is determined cyclically (initiated by the module) and is exactly synchronized with the ACOPOS controller clock. The input signals are monitored for both encoder types. In this way, broken connections, shorted lines and encoder supply failure can be recognized.

With incremental encoders the count frequency and distance between edges is also monitored. With absolute encoders, the parity bit is evaluated and a plausibility check carried out.

2.7.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	

AC 123
UP
DN
27 /03
2882 BS

Table 30: Order data for AC123

2.7.3 Technical Data

Product ID	**8AC123.60-1**
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot [1)]	Slots 2, 3 and 4
Power Consumption	Max. 7.5 W Depends on the current requirements for the encoder connected [2)]
Encoder Input [3)]	
Connection, Module Side	15-pin DSUB socket
Indications	UP/DN LEDs
Electrical Isolation Encoder - ACOPOS	 Yes
Encoder Monitoring	Yes
Signal Transfer	Differential signal transfer
Cable length [4)]	Max. 50 m
Encoder Supply	
Supply Voltages	Internal, select between 5 V/15 V
Sense Lines for 5 V for 15 V	 Yes, 2, compensation of max. 2 V No
Current Handling Capacity 5 V 15 V	 350 mA 350 mA
Short Circuit Protection, Overload Protection	Yes
Incremental Encoders [5)]	
Signal Form	Square wave pulse
Evaluation	4-fold
Input Frequency	Max. 200 kHz
Count Frequency	Max. 800 kHz
Reference Frequency	Max. 200 kHz
Distance Between Edges	Min. 0.6 µs
Counter Size	32 bits
Inputs	A, A\, B, B\, R, R\
Differential Voltage Inputs A, B, R Minimum Maximum	 2.5 V 6 V
SSI Absolute Encoder	
Coding	Gray, Binary
Baud Rate	200 kBaud
Word Size	Max. 31 bit

Table 31: Technical data for AC123

Product ID	8AC123.60-1
Differential Voltage Clock Output - 120 Ω Minimum Maximum	 2.5 V 5 V
Differential Voltage Data Input Minimum Maximum	 2.5 V 6 V
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 31: Technical data for AC123 (Forts.)

1) The AC123 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) The power consumption of the plug-in module can be approximated using the following formula:

   P_{Module} [W] = $P_{Encoder}$ [W] · k + 0.6 W

   The power consumed by the encoder $P_{Encoder}$ is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:

   $P_{Encoder}$ [W] = $U_{Encoder}$ [V] · $I_{Encoder}$ [A]

   The following values must be used for k:

   k = 1.2 (for 15 V encoder supply)
   k = 1.75 (for 5 V encoder supply)
3) The encoder must be wired using a cable with a single shield and twisted pair signal lines (e.g. 4 x 2 x 0.14 mm² + 2 x 0.5 mm²).
4) A cable with at least 4 x 2 x 0.14 mm² + 2 x 0.5 mm² is required for the maximum cable length. The sense lines must be used.
5) Incremental encoders can be used as motor feedback only for asynchronous motors, but can only provide limited control quality for this purpose. An encoder with at least 1000 lines must be used for motor feedback.

2.7.4 Indications

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.
DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.7.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.8 AC130 - Digital Mixed Module

2.8.1 General Description

The AC130 plug-in module can be used in an ACOPOS slot. A maximum of 8 digital inputs or 10 digital outputs are available.

I/O points can be configured in pairs as inputs or outputs. The first three inputs have incremental encoder functionality (A, B, R). The first two outputs can be operated in pulse width modulation (PWM) mode.

The inputs are divided into 4 standard (max. 10 kHz) and 4 high speed (max. 100 kHz) inputs.

The outputs include 4 high speed (push-pull) outputs with a maximum current of 100 mA, 4 standard (high-side) outputs with a maximum current of 400 mA and 2 low speed (high-side) outputs with a maximum current of 2 A. All outputs can be read.

2.8.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
	Terminal Blocks	
7TB712.9	Terminal block, 12 pin, screw clamps	
7TB712.91	Terminal block, 12 pin, cage clamps	
7TB712:90-02	Terminal block, 12 pin, 20 pcs., screw clamps	
7TB712:91-02	Terminal block, 12-pin, 20 pcs., cage clamps	
Order TB 712 terminal block separately!		

Table 32: Order data for AC130

2.8.3 Technical Data

Product ID	**8AC130.60-1**
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot 1)	Slots 2, 3 and 4
Power Consumption	Max. 0.8 W
Inputs/Outputs	
Connection, Module Side	12 conductor pin-connector
Configuration of the Inputs/Outputs	Configured in pairs as input or output
Display	24 V LED
Supply Voltage	
Supply Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Reverse Polarity Protection	Yes
Voltage Monitoring (24 V - LED)	Yes, supply voltage > 18 V
Digital Inputs 2)	
Number of Inputs	Max. 8
Wiring	Sink
Electrical Isolation Input - ACOPOS Input - Input	 Yes No
Input Voltage Nominal Maximum	 24 VDC 30 VDC
Switching Threshold LOW HIGH	 < 5 V >15 V
Input Current at Nominal Voltage Inputs 1 -4 Inputs 5 - 8	 Approx. 10 mA Approx. 5.5 mA
Switching Delay Inputs 1 -4 Inputs 5 - 8	 Max. 5 µs Max. 35 µs
Modulation Compared to Ground Pot.	---
Event Counter	
Signal Form	Square wave pulse
Input Frequency	Max. 100 kHz
Counter Size	16 bits
Inputs Input 1 Input 2	 Counter 1 Counter 2

Table 33: Technical data for AC130

Product ID	8AC130.60-1
Incremental Encoders	
Signal Form	Square wave pulse
Evaluation	4-fold
Encoder Monitoring	No
Input Frequency	Max. 62.5 kHz
Count Frequency	Max. 250 kHz
Reference Frequency	Max. 62.5 kHz
Distance Between Edges	Min. 2.5 µs
Counter Size	16 bits
Inputs Input 1 Input 2 Input 3	 Channel A Channel B Reference pulse R
Outputs	
Number of Outputs	Max. 10
Type Outputs 1 -4 Outputs 5 - 10	Transistor outputs Push-pull High-side
Electrical Isolation Output - ACOPOS Output - Output	 Yes No
Switching Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	 Max. 100 mA Max. 400 mA Max. 2 A
Switching Delay 0 -> 1 and 1 -> 0 Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	 Max. 5 µs Max. 50 µs Max. 500 µs
Switching Frequency (resistive load) Outputs 1 -2 Outputs 3 -4 Outputs 5 -8 Outputs 9 - 10	 Max. 10 kHz (max. 20 kHz in PWM mode) Max. 10 kHz Max. 5 kHz Max. 100 Hz
PWM Outputs 1 - 2 Resolution of the Pulse Width Period Duration	 13 bits 50 µs - 400 µs
Protection Short Circuit Protection Overload Protection	 Yes Yes

Table 33: Technical data for AC130 (Forts.)

Product ID	**8AC130.60-1**
Short Circuit Current at 24 V (until cut-off) Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	 Approx. 1 A Approx. 1.2 A Approx. 24 A
Readable Outputs	Yes
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 33: Technical data for AC130 (Forts.)

1) The AC130 can also be used as an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.

2) Shielded cables must be used for inputs 1 - 4.

2.8.4 Indications

The 24V LED is lit as soon as the supply voltage for the plug-in module goes above 18 VDC.

2.8.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.9 AC131 - Mixed Module

2.9.1 General Description

The AC131 plug-in module can be used in an ACOPOS slot. A maximum of 2 analog inputs (±10 V differential inputs or single-ended inputs) and 2 digital inputs or digital outputs are available.

The analog inputs have a resolution of 12 bits and are scanned synchronously using the 50 μs clock for the ACOPOS servo drive. The analog inputs have a 10 kHz analog input filter (low pass 3rd order).

The digital inputs and outputs can be configured individually as input or output. The digital inputs are equipped with a counter function. The digital outputs (push-pull) can be read.

2.9.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as a 24V input or 45mA output, Order TB712 terminal block separately	
	Terminal Blocks	
7TB712.9	Terminal block, 12 pin, screw clamps	
7TB712.91	Terminal block, 12 pin, cage clamps	
7TB712:90-02	Terminal block, 12 pin, 20 pcs., screw clamps	
7TB712:91-02	Terminal block, 12-pin, 20 pcs., cage clamps	
Order TB 712 terminal block separately!		

Table 34: Order data for AC131

2.9.3 Technical Data

Product ID	8AC131.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slots 2, 3 and 4
Power Consumption	Max. 1 W
Inputs/Outputs	
Connection, Module Side	12 conductor pin-connector
Configuration of the Digital Inputs/Outputs	Can be configured individually as digital input or output
Display	24 V LED
Supply Voltage	
Supply Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Reverse Polarity Protection	Yes
Voltage Monitoring (24 V - LED)	Yes, supply voltage > 18 V
Digital Inputs	
Number of Inputs	Max. 2
Wiring	Sink
Electrical Isolation Input - ACOPOS Input - Input	 Yes No
Input Voltage Nominal Maximum	 24 VDC 30 VDC
Switching Threshold LOW HIGH	 < 5 V >15 V
Input Current at Nominal Voltage	Approx. 8 mA
Switching Delay Counters Digital Input	 Max. 5 µs Max. 55 µs (digitally filtered)
Modulation Compared to Ground .	Max. ±50 V
Event Counter	
Signal Form	Square wave pulse
Input Frequency	Max. 100 kHz
Counter Size	16 bits
Inputs Input 1 Input 2	 Counter 1 Counter 2

Table 35: Technical data for AC131

Product ID	8AC131.60-1
Digital Outputs	
Number of Outputs	Max. 2
Type	Transistor outputs push-pull
Electrical Isolation Output - ACOPOS Output - Output	 Yes No
Switching Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current	Max. 45 mA
Switching Delay 0 -> 1 and 1 -> 0	Max. 5 µs
Switching Frequency (resistive load)	Max. 100 kHz
Protection Short Circuit Protection Overload Protection	 Yes Yes
Short Circuit Current at 24 V (until cut-off)	Approx. 0.3 A
Readable Outputs	Yes
Analog Inputs	
Number of Inputs	Max. 2
Design	Differential input or single ended input
Electrical Isolation Input - ACOPOS Input - Input	 Yes No
Input Signal Nominal Maximum	 -10 V to +10 V -15 V to +15 V
Operating Mode	Cyclic measurement synchronous to 50 µs ACOPOS clock
Digital Converter Resolution	12 bits
Non-linearity	±1 LSB
Output Format	INT16 $8000 - $7FF01 LSB = $0010 = 4.883 mV
Conversion Procedure	Successive approximation
Conversion Time for Both Inputs	<50 µs
Differential Input Impedance	> 10 MΩ
Input Filter	Analog low pass 3rd order / cut-off frequency: 10 kHz
Basic Accuracy at 25° C	±0.05 % [1)]
Offset Drift	Max. ±0.0005 % / °C [1)]
Gain Drift	Max. ±0.006 % / °C [1)]
Cross-talk Between the Analog Inputs	Min. -90 dB at 1kHz
Common-mode Rejection DC 50 Hz	 Min. -73 dB Min. -73 dB
Modulation Compared to Ground Pot.	Max. ±50 V

Table 35: Technical data for AC131 (Forts.)

Product ID	**8AC131.60-1**
Modulation Between the Analog Input Channels	Max. ±5 V
Operational Conditions	
Environmental Temperature During Operation	0 to +50 °C
Relative Humidity During Operation	5 to 95%, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity During Storage	5 to 95%, non-condensing
Transport Temperature	-25 to +70° C
Relative Humidity During Transport	95 % at +40 °C

Table 35: Technical data for AC131 (Forts.)

1) Refers to the measurement range limit.

2.9.4 Indications

The 24V LED is lit as soon as the supply voltage for the plug-in module goes above 18 VDC.

2.9.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.10 AC140 - CPU Module

2.10.1 General Description

The AC110 plug-in module can be used in an ACOPOS slot (requires two slots).

The CPU module makes it possible to operate an ACOPOS servo drive without external PLC and is also available with integrated "Soft CNC" system (8AC140.61-2).

Communication in the ACOPOS network occurs as described in section 2.3.1 "Drive-based Automation with ACOPOS™" on page 27.

The ACOPOS servo drive connection which the AC140 is plugged into, has an emulation of an AC110 - CAN interface plug-in module on slot 1. All other CAN stations are connected via the CAN interface IF2.

The module offers interchangeable application memory in the form of a Compact Flash card as well as a separate backup battery for the module. 1)

It is equipped with up to four application interfaces:

- one RS232 interface (IF1) for programming and configuring using B&R Automation Studio™
- one CAN interface (IF2) for connecting to a CAN network
- one Profibus DP slave interface (IF3) for connecting to a Profibus network.
- one Ethernet interface (IF6) for connecting to an Ethernet network
  (only 8AC140.61-2)

In addition, a maximum of three digital inputs / outputs are provided as well as one analog input (±10 V differential input).

The digital inputs and outputs can be configured individually as input or output. Additional functions such as a counter function or period and gate measurement are integrated. It is also possible to control a stepper motor.
The inputs and outputs are scanned directly by the CPU module; the ACOPOS servo drive does not have direct access to these inputs and outputs.

The analog input has a resolution of 12 bits and an analog input filter with 10 kHz (low pass 3rd order).

---

1) The application memory must be ordered separately.

2.10.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	 8AC140.60-1 8AC140.61-2
8AC140.60-1	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 8 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!	
8AC140.61-2	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, exchangeable application memory: Compact Flash, 1 CAN interface, 1 Ethernet interface, 1 Profibus-DP slave interface, 1 RS232 interface, Order application memory separately!	
	Program memory	
5CFCRD.0032-01	Compact Flash 32 MB ATA/IDE SanDisk	
5CFCRD.0064-01	Compact Flash 64 MB ATA/IDE SanDisk	
5CFCRD.0128-01	Compact Flash 128 MB ATA/IDE SanDisk	
5CFCRD.0256-01	Compact Flash 256 MB ATA/IDE SanDisk	
5CFCRD.0512-01	Compact Flash 512 MB ATA/IDE SanDisk	
	Terminal Blocks	
0TB708.91	Accessory terminal block, 8-pin, cage clamps 1.5 mm^2	
0TB708.92-01	Accessory terminal block, 20 pcs. 8-pin cage clamps 1.5 mm^2	
	Accessories	
0G0001.00-090	Cable PC <-> PLC/PW, RS232, online cable	
7AC911.9	Bus connector, CAN	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm connection cable	
Order application memory and TB 708 terminal block separately!		

Table 36: Order data for AC140

2.10.3 Technical Data

Product ID	8AC140.60-1	8AC140.61-2
General Information		
C-UL-US Listed	In preparation	
Module Type	ACOPOS plug-in module double-width	
Slot 1)	Slots 1 + 2	
Power Consumption	Max. 4.5 W	

Table 37: Technical data for AC140

Product ID	**8AC140.60-1**	**8AC140.61-2**
CPU		
Processor Clock	100 MHz	
SRAM	32 kB	
DRAM	8 MB	16 MB
Operating System	AC140 (version V2.67 and higher)	
Application Interface IF1		
Interface Type	RS232	
Electrical Isolation	No	
Design	9-pin DSUB plug	
Max. Distance	15m / 19,200 baud	
Max. Baud Rate	115.2 kBaud	
Display	X1 LED	
Application Interface IF2		
Interface Type	CAN	
Electrical Isolation	Yes	
Design	9-pin DSUB plug	
Max. Distance	1000 m	
Max. Baud Rate Bus Lengths up to 60 m Bus Lengths up to 200 m Bus Lengths up to 1000 m	 500 kBit/s 250 kBit/s 50 kBit/s	
Indications	RX / TX LEDs	
Network Capable	Yes	
Bus Termination Resistor	Externally wired	
Application Interface IF3		
Interface Type	RS485	
Transfer Protocol	Profibus DP	
Electrical Isolation	Yes	
Design	9-pin DSUB socket	
Controllers	ASIC SPC3	
RAM	1.5 kByte	
Max. Distance	1000 m	
Max. Baud Rate Bus Lengths up to 100 m Bus Lengths up to 200 m Bus Lengths up to 400 m Bus Lengths up to 1000 m	 12 MBit/s 1.5 MBit/s 500 kBit/s 187.5 kBit/s	
Indications	RX / TX LEDs	PB LED
Network Capable	Yes	
Bus Termination Resistor	External T-connector	

Table 37: Technical data for AC140 (Forts.)

Product ID	**8AC140.60-1**	**8AC140.61-2**
Application Interface IF5		
Interface Type	---	Ethernet
Electrical Isolation	---	Yes
Design	---	RJ45 plug
Max. Distance	---	100 m
Baud Rate	---	10/100 MBaud
Display	---	ACT LED
Network Capable	---	Yes
Inputs/Outputs		
Connection, Module Side	8-pin connector	
Configuration of the digital inputs/outputs	Can be configured individually as input or output	
Digital inputs [2)]		
Number of Inputs	Max. 3	
Wiring	Sink	
Electrical Isolation Input - ACOPOS Input - Input	 Yes No	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Switching Threshold LOW HIGH	 <5 V >15 V	
Input Current at Nominal Voltage	Approx. 4.2 mA	
Input Delay	<5 µs	
Modulation Compared to Ground Pot.	Max. ±30 V	
Event Counter		
Signal Form	Square wave pulse	
Input Frequency	Max. 100 kHz	
Pulse Length	Min. 5 µs	
Counter Size	32 bit	
inputs Input 1 Input 2 Input 3	 Counter 1 --- ---	
Incremental Counter		
Signal Form	Square wave pulse	
Evaluation	4-fold	
Encoder Monitoring	No	
Input Frequency	Max. 20 kHz	
Count Frequency	Max. 80 kHz	

Table 37: Technical data for AC140 (Forts.)

Product ID	**8AC140.60-1**	**8AC140.61-2**
Reference Frequency	Max. 20 kHz	
Distance Between Edges	Min. 5 µs	
Counter Size	16-bit	
Inputs		
Input 1	Channel A	
Input 2	Channel B	
Input 3	Reference pulse R	
Gate Measurement		
Signal Form	Square wave pulse	
Gate Frequency	Max. 100 kHz	
Pulse Length	Min. 5 µs	
Count Frequency		
Internal	31.25 kHz or 4 MHz	
External	Max. 100 kHz	
Period Measurement		
Signal Form	Square wave pulse	
Input Frequency	Max. 100 kHz	
Pulse Length	Min. 5 µs	
Count Frequency		
Internal	31.25 kHz or 4 MHz	
External	Max. 100 kHz	
Digital Outputs		
Number of Outputs	Max. 3	
Type	High-side transistor outputs	
Electrical Isolation		
Output - ACOPOS	Yes	
Output - Output	No	
Switching Voltage		
Minimum	18 VDC	
Nominal	24 VDC	
Maximum	30 VDC	
Continuous Current	Max. 500 mA	
Switching Delay 0 -> 1 and 1 -> 0	Max. 500 µs (typ. 250 µs)	
Switching Frequency (resistive load)	Max. 100 Hz	
Protection		
Short Circuit Protection	Yes	
Overload Protection	Yes	
Continuous Short Circuit Current at 24 V	Typ. 4 A	
Readable Outputs	Yes	
Analog Input		
Design	Differential input	
Electrical Isolation		
Input - ACOPOS 3)	No, max. modulation: ± 13 V	

Table 37: Technical data for AC140 (Forts.)

Product ID	8AC140.60-1	8AC140.61-2
Input Signal Nominal Maximum	 -10 V to +10 V -13 V to +13 V	
Operating Mode	Cyclic measurement non-synchronous to 50 µs ACOPOS clock	
Digital Converter Resolution	12-bit	
Non-linearity	±2 LSB	
Output Format	INT 16 $8001 - $7FFF LSB = $0010 = 4.88 mV	
Conversion Procedure	Successive approximation	
Conversion Time	<50 µs	
Differential Input Impedance	20 MOhm	
Input Filter	Analog low pass 3rd order / cut-off frequency: 10 kHz	
Common-mode Rejection DC 50 Hz	 Min. 73 dB Min. 73 dB	
Operational Conditions		
Environmental Temperature During Operation	0 to +45 °C	
Relative Humidity During Operation	5 to 95%, non-condensing	
Storage and Transport Conditions		
Storage Temperature	-25 to +55 °C	
Relative Humidity During Storage	5 to 95%, non-condensing	
Transport Temperature	-25 to +70° C	
Relative Humidity During Transport	95 % at +40 °C	

Table 37: Technical data for AC140 (Forts.)

1) The AC140 is a module with double-width and occupies slots 1 and 2.
2) Shielded cables must be used for inputs 1 -3.
3) An external electrical isolation of the connected sensors is recommended because the analog input is not electrically isolated.

2.10.4 Indications

8AC140.60-1

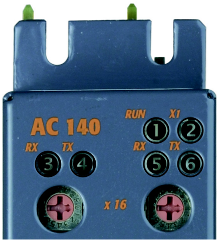
Image	LED	Description	Color	Description
 AC 140 RUN X1 RX TX RX TX 1 2 3 4 5 6 x 16	❶	Status (RUN)	Red Red with orange blinking Red/green blinking (1 Hz) Orange Green Green with orange blinking	ERROR/RESET Load/unload and start BOOT AR Startup of BOOT or CF - AR SERVICE/DIAG/BOOT mode RUN RUN - BATTERY LOW
	❷	RS232 (X1)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	Profibus (RX)	Orange	Receive data on application interface IF3 (Profibus)
	❹	Profibus (TX)	Orange	Send data to application interface IF3 (Profibus)
	❺	CAN (RX)	Orange	Receive data on application interface IF2 (CAN)
	❻	CAN (TX)	Orange	Send data to application interface IF2 (CAN)

Table 38: Indications 8AC140.60-1

8AC140.61-2

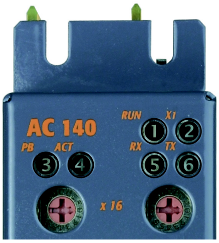
Image	LED	Description	Color	Description
 AC 140 RUN X1 PB ACT RX TX 1 2 3 4 5 6 x 16	❶	Status (RUN)	Red Red with orange blinking Red/green blinking (1 Hz) Orange Green Green with orange blinking	ERROR/RESET Load/unload and start BOOT AR Startup of BOOT or CF - AR SERVICE/DIAG/BOOT mode RUN RUN - BATTERY LOW
	❷	RS232 (X1)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	Profibus (PB)	Orange	Data transfer on application interface IF3 (Profibus)
	❹	Ethernet (ACT)	Orange Orange blinking	Ethernet LINK (IF6) Ethernet ACTIVE (IF6)
	❺	CAN (RX)	Orange	Receive data on application interface IF2 (CAN)
	❻	CAN (TX)	Orange	Send data to application interface IF2 (CAN)

Table 39: Indications 8AC140.61-2

2.10.5 CAN Node Number Setting (IF2)

The CAN node number can be set using two HEX code switches:

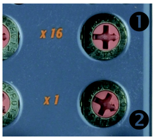
Image	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)

Table 40: Setting the CAN node number

The CAN node number change takes effect the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

Information:

The CAN bus IF2 is always made up of at least two stations, integrated in the AC140: the AC140 CPU and an AC110 emulation, which the ACOPOS uses for communication. Therefore, the AC140 CPU prevents a potential error in which no other stations are found on the CAN bus. This is why the AC140 CPU does not register a hardware error if there is no physical connection to external CAN devices.

2.10.6 Profibus Station Number Setting (IF3)

The Profibus station number can be set using two HEX code switches:

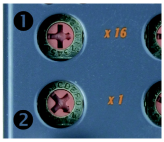
Image	Code switch	Description
	❶	Profibus station number 16s position (high)
	❷	Profibus station number 1s position (high)

Table 41: Setting the Profibus station number

The Profibus station number change takes effect the next time the ACOPOS servo drive is switched on.

2.10.7 Ethernet Station Number Setting (IF6)

The Ethernet station number can be set with software (B&R Automation Studio™).

2.10.8 Reset Button

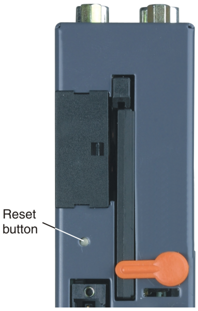
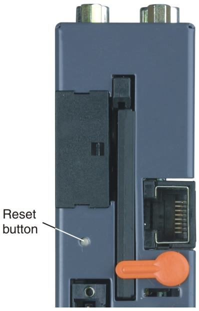
View (view from below)	Description
 8AC140.60-1  8AC140.61-2	The reset button can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means: • All application programs are stopped. • All outputs are set to zero. The AC140 then switches to SERVICE mode.

Table 42: Reset button

2.10.9 Program Memory Slot (Compact Flash)

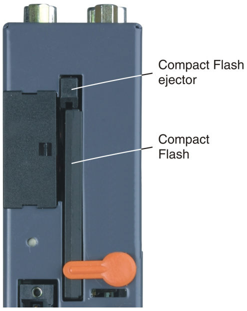
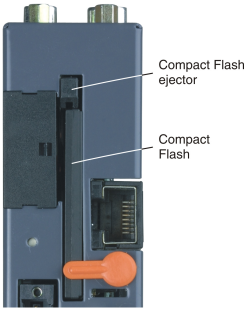
View (view from below)	Description
 8AC140.60-1  8AC140.61-2	Program memory is required to operate the AC140. The program memory is Compact Flash. This is not included with the delivery of the AC140. Compact Flash must be ordered separately as an accessory! The Compact Flash memory card is used in the slot on the bottom of the AC140. Press the eject button to remove the card. The Compact Flash memory card can be secured using a safety clip.

Table 43: Program memory

2.10.10 Backup Battery

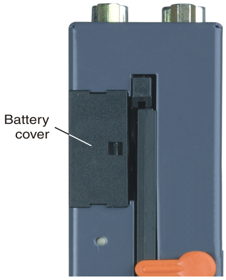
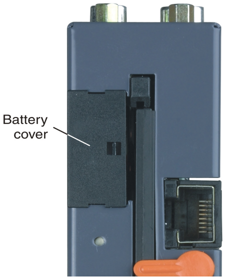
<table>
<tr><th>View (view from below)</th><th colspan="2">Description</th></tr>
<tr><td rowspan="8">
8AC140.60-1

8AC140.61-2</td><td colspan="2">The AC140 is equipped with a lithium battery. The lithium battery is placed in a separate compartment on the bottom of the module and protected by a cover.</td></tr>
<tr><th colspan="2">Buffer battery data</th></tr>
<tr><td>Lithium battery</td><td>3 V / 950 mAh</td></tr>
<tr><td>Model number</td><td>0AC201.9</td></tr>
<tr><td>Short description</td><td>Lithium batteries, 5 pcs.,
3 V / 950 mAh, button cell</td></tr>
<tr><td>Storage temperature</td><td>-20 to +60° C</td></tr>
<tr><td>Storage time</td><td>Max. 3 years at 30° C</td></tr>
<tr><td>Relative humidity</td><td>0 to 95 % (non-condensing)</td></tr>
</table>

Table 44: Backup battery

Data / real-time buffering

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten the battery life, instead it gives an early warning of weakened buffer capacity.

The status information, "Battery OK" is available from the system library function "BatteryInfo".

Battery change interval

The battery should be changed every 4 years. The change interval refers to the average life span and operating conditions and is recommended by B&R. It does not correspond to the maximum buffer duration.

> ## Information:
>
> **Data stored in the AC140 RAM will be lost if the battery is changed with the PLC switched off! The battery can be changed with power applied, but this is not allowed in all countries!**

2.10.11 Input /Output Register

Digital in r/- (16 Bit):

Bit No.	Value	Description
0		Logical status of digital I/O 1
1		Logical status of digital I/O 2
2		Logical status of digital I/O 3
3 - 15		Reserved

Digital out r/w (16 Bit):

All reserved bits must be written with 0.

Bit No.	Value	Description
0	0	Digital output 1 is inactive
	1	Digital output 1 is active
1	0	Digital output 2 is inactive
	1	Digital output 2 is active
2	0	Digital output 3 is inactive
	1	Digital output 3 is active
3 - 15		Reserved

Analog in (16 Bit) r/-:

±10V (12 bit resolution)

Counter (32 Bit) r/(w):

In addition to the typical counter modes, this counter has a "Stepper motor counter mode" (see Configuration register bits 4-6).

In stepper motor counter mode, the counter direction is preset via digital I/O 2 (0… increment, 1 … decrement), while the counter clock is on digital I/O 1. Only one clock edge is used for counting (can be configured with bit 3 of the counter configuration register).

Counter configuration (16 bit) r/w:

All reserved bits must be written with 0.

Bit No.	Value	Description
0		Reserved
1	0	AB(R) counter mode: R input disabled
	1	AB(R) counter mode: R input enabled
2		Reserved
3	0	Measurement starts at increasing edge
	1	Measurement starts at decreasing edge
4 - 6	000	No counter operation
	001	AB(R) counter mode
	010	Event counter mode
	011	Period measurement mode
	100	Stepper motor counter mode
	101	Gate measurement mode
	110	Not allowed
	111	Not allowed
7 - 8	00	Counter frequency 4MHz
	01	External counter frequency
	10	Counter frequency 31.25 kHz
	11	Not allowed
9	0	Counter overflow recognition disabled / Reset counter overflow bit
	1	Overflow recognition of the continuous counter is enabled (value limited to $FFFF)
10 - 14		Reserved
15	0	Time / counter reset
	1	Time / counter enabled (ATTENTION: Only set bit after counter configuration is complete)

Status (16 Bit) r/- :

Bit No.	Value	Description
0 - 8		Reserved
9	0	Period or gate measurement within the counter range 0 - $FFFF (only valid if bit 9 is set in the counter configuration word)
	1	Counter overflow during period or gate measurement. Acknowledge by resetting bit 9 of the counter configuration word.
10 - 14		Reserved
15	0	Output supply voltage monitoring 24VDC is OK
	1	Output supply voltage monitoring 24VDC error

3. Cables

3.1 General Information

B&R offers the cables for ACOPOS servo drives in six different lengths. All cables can be used for drag chain installations. [1]

To prevent disturbances to encoder signals, the holding brake and temperature sensor wires are in the motor cable and not in the EnDat or resolver cable.

3.1.1 Prefabricated Cables

Using B&R cables guarantees that the EMC limits are not exceeded. The cables are prefabricated in the EU and are therefore subject to the strictest quality standards.

> ## Information:
>
> **If other cables are used, make sure that they have the same wave parameters and the same design as the respective B&R cable. If deviations exist, additional measures are necessary to ensure that EMC guidelines are met.**

---

1) Custom fabrication of motor cables is available on request. For custom fabrication of motor cables, the plug size must be matched to the motor used!

3.2 Motor Cables

3.2.1 Order Data

Model Number	Short Description	Image
	Motor Cables 1.5 mm^2 1)	
8CM005.12-1	Motor cable, length 5m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-1	Motor cable, length 7m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-1	Motor cable, length 10m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-1	Motor cable, length 15m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-1	Motor cable, length 20m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-1	Motor cable, length 25m, 4 x 1.5mm^2 + 2 x 2 x 0.75mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
	Motor Cables 4 mm^2 2)	
8CM005.12-3	Motor cable, length 5m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-3	Motor cable, length 7m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-3	Motor cable, length 10m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-3	Motor cable, length 15m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-3	Motor cable, length 20m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-3	Motor cable, length 25m, 4 x 4mm^2 + 2 x 2 x 1mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
	Motor Cables 10 mm^2 3)	
8CM005.12-5	Motor cable, length 5m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-5	Motor cable, length 7m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-5	Motor cable, length 10m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-5	Motor cable, length 15m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-5	Motor cable, length 20m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-5	Motor cable, length 25m, 4 x 10mm^2 + 2 x 2 x 1.5mm^2, Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	

Table 45: Order data for motor cables

Model Number	Short Description	Image
	Motor Cables 35 mm^2	
8CM005.12-8	Motor cable, length 5m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	
8CM007.12-8	Motor cable, length 7m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	
8CM010.12-8	Motor cable, length 10m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	
8CM015.12-8	Motor cable, length 15m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	
8CM020.12-8	Motor cable, length 20m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	
8CM025.12-8	Motor cable, length 25m, 4 x 35mm^2 + 2 x 2 x 1.5mm^2, can be used in cable drag chains, UL/CSA listed	

Table 45: Order data for motor cables (Forts.)

1) Standard fabrication; designed for use with ACOPOS servo drives 8V1022.00-x, 8V1045.00-x and 8V1090.00-x and motor sizes 2 to 7.
2) Standard fabrication; designed for use with ACOPOS servo drives 8V1180.00-x and 8V1320.00-x and motor sizes 2 to 7.
3) Standard fabrication; designed for use with ACOPOS servo drives 8V1640.00-x and 8V128M.00-x and motor size 8.

3.2.2 Technical Data

1.5 and 4 mm^2 motor cables

Product ID	Motor Cables 1.5 mm^2	Motor Cables 4 mm^2
General Information		
Cable Cross Section	4 x 1.5 mm^2 + 2 x 2 x 0.75 mm^2	4 x 4 mm^2 + 2 x 2 x 1 mm^2
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil	
Certification	UL AWM Style 20669, 90 °C, 600 V, E63216 and CSA AWM I/II A/B, 90 °C, 600 V, FT1 LL46064	
Conductor		
Power Lines	1.5 mm^2, tinned Cu wire	4 mm^2, tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	Black, brown, blue, yellow/green	
Signal Lines	0,75 mm^2, tinned Cu wire	1 mm^2, tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	White, white/red, white/blue, white/green	
Cable Structure		
Power Lines		
Stranding	No	
Shielding	No	
Signal Lines		
Stranding	White with white/red and white/blue with white/green	
Shielding	Separate shielding for pairs, tinned Cu mesh, optical coverage > 85% and foil banding	
Cable Stranding	With filler elements and foil banding	
Cable Shielding	Tinned Cu mesh, optical coverage > 85 % and wrapped in isolating fabric	
Outer Sheathing		
Material	PUR	
Color	Orange, similar to RAL 2003 flat	
Labeling	BERNECKER + RAINER 4x1.5+2x2x0.75 FLEX	BERNECKER + RAINER 4x4.0+2x2x1.5 FLEX
Electrical Characteristics		
Conductor Resistance		
Power Lines	$\leq$ 14 Ω/km	$\leq$ 5.2 Ω/km
Signal Lines	$\leq$ 29 Ω/km	$\leq$ 14 Ω/km
Insulation Resistance	> 200 MΩ per km	
Isolation Voltage		
Wire/Wire	3 kV	
Wire/Shield	1 kV	
Operating Voltage	Max. 600 V	
Mechanical Characteristics		
Temperature Range		
Moving	-10 °C to +70 °C	
Static	-20 °C to +90 °C	
Outer Diameter	12.8 mm ± 0.4 mm	15.8 mm ± 0.5 mm
Flex Radius	> 96 mm	> 118.5 mm
Speed	$\leq$ 4 m/s	
Acceleration	< 60 m/s^2	
Flex Cycles	$\geq$ 3,000,000	
Weight	0.26 kg/m	0.45 kg/m

Table 46: Technical data for motor cables 1.5 and 4 mm^2

10 and 35 mm^2 motor cables

Product ID	**Motor Cables 10 mm^2**	**Motor Cables 35 mm^2**
General Information		
Cable Cross Section	4 x 10 mm^2 + 2 x 2 x 1.5 mm^2	4 x 35 mm^2 + 2 x 2 x 1.5 mm^2
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil	
Certification	UL AWM Style 20669, 90 °C, 600 V, E63216 and CSA AWM I/II A/B, 90 °C, 600 V, FT1 LL46064	
Conductor		
Power Lines	10 mm^2, tinned Cu wire	35 mm^2, tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	Black, brown, blue, yellow/green	
Signal Lines	1.5 mm^2, tinned Cu wire	
Wire Insulation	Special thermoplastic material	
Wire Colors	White, white/red, white/blue, white/green	
Cable Structure		
Power Lines		
Stranding	No	
Shielding	No	
Signal Lines		
Stranding	White with white/red and white/blue with white/green	
Shielding	Separate shielding for pairs, tinned Cu mesh, optical coverage > 85% and foil banding	
Cable Stranding	With filler elements and foil banding	
Cable Shielding	Tinned Cu mesh, optical coverage > 85 % and wrapped in isolating fabric	
Outer Sheathing		
Material	PUR	
Color	Orange, similar to RAL 2003 flat	
Labeling	BERNECKER + RAINER 4x10.0+2x2x1.5 FLEX	BERNECKER + RAINER 4x35.0+2x2x1.5 FLEX
Electrical Characteristics		
Conductor Resistance		
Power Lines	≤ 2.1 Ω/km	≤ 0.6 Ω/km
Signal Lines	≤ 14 Ω/km	≤ 14 Ω/km
Insulation Resistance	> 200 MΩ per km	
Isolation Voltage		
Wire/Wire	3 kV	
Wire/Shield	1 kV	
Operating Voltage	Max. 600 V	
Mechanical Characteristics		
Temperature Range		
Moving	-10 °C to +70 °C	
Static	-20 °C to +90 °C	
Outer Diameter	20.1 mm ± 0.7 mm	32.5 mm ± 1 mm
Flex Radius	> 150.8 mm	> 243.8 mm
Speed	≤ 4 m/s	
Acceleration	< 60 m/s^2	
Flex Cycles	≥ 3,000,000	
Weight	0.77 kg/m	2.2 kg/m

Table 47: Technical data for motor cables 10 and 35 mm^2

3.3 EnDat Cable

3.3.1 Order Data

Model Number	Model Number	Image
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat cable, length 7m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat cable, length 10m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat cable, length 15m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat cable, length 20m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat cable, length 25m, 10 x 0.14mm^2 + 2 x 0.5mm^2, EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 48: Order data for EnDat cables

3.3.2 Technical Data

Product ID	EnDat Cables
General Information	
Cable Cross Section	10 x 0.14 mm^2 + 2 x 0.50 mm^2
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil
Certification	UL AWM Style 20963, 80 °C, 30 V, E63216 and CSA AWM I/II A/B, 90 °C, 30 V, FT1 LL46064
Conductor	
Signal Lines Wire Insulation Wire Colors	0.14 mm^2, tinned Cu wire Special thermoplastic material Blue, brown, yellow, gray, green, pink, red, black, violet, white
Supply Lines Wire Insulation Wire Colors	0.5 mm^2, tinned Cu wire Special thermoplastic material White/green, white/red
Cable Structure	
Signal Lines Stranding Shielding	Green with brown, gray with yellow, white with violet, black with red, pink with blue No
Supply Lines Stranding Shielding	White/red with white/green and filler elements No
Cable Stranding	With foil banding

Table 49: Technical data for EnDat cables

Product ID	EnDat Cables
Cable Shielding	Cu mesh, optical coverage > 85 % and wrapped in isolating fabric
Outer Sheathing Material Color Labeling	 PUR RAL 6018 BERNECKER + RAINER 10x0.14+2x0.50 FLEX
Electrical Characteristics	
Conductor Resistance Signal Lines Supply Lines	 ≤ 140 Ω/km ≤ 40 Ω/km
Insulation Resistance	> 200 MΩ per km
Isolation Voltage Wire/Wire Wire/Shield	 1.5 kV 0.8 kV
Operating Voltage	Max. 30 V
Mechanical Characteristics	
Temperature Range Moving Static	 -10 °C to +70 °C -20 °C to +90 °C
Outer Diameter	7.3 mm ± 0.25 mm
Flex Radius	> 55 mm
Speed	≤ 4 m/s
Acceleration	< 60 m/s²
Flex Cycles	≥ 3,000,000
Weight	0.08 kg/m

Table 49: Technical data for EnDat cables (Forts.)

3.4 Resolver Cables

3.4.1 Order Data

Model Number	Short Description	Image
8CR005.12-1	Resolver cable, length 5m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 50: Order data for resolver cables

3.4.2 Technical Data

Product ID	Resolver Cables
General Information	
Cable Cross Section	3 x 2 x 24 AWG/19
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil
Certification	UL AWM Style 20671, 90°C, 30 V, E63216 and CSA AWM, 90°C, 30 V, I/II A/B FT1 LL46064
Conductor	
Signal Lines Wire Insulation Wire Colors	24 AWG/19, tinned Cu wire Special thermoplastic material White, brown, green, yellow, gray, pink
Cable Structure	
Signal Lines Stranding Shielding	White with brown, green with yellow, gray with pink No
Cable Stranding	The 3 pairs together covered by foil banding
Cable Shielding	Cu mesh, optical coverage ≥ 90% and wrapped in isolating fabric
Outer Sheathing Material Color Labeling	PUR RAL 6018 BERNECKER + RAINER 3x2x24 AWG FLEX

Table 51: Technical data for resolver cables

Product ID	Resolver Cables
Electrical Characteristics	
Conductor Resistance 24 AWG	≤ 86 Ω/km
Insulation Resistance	> 200 MΩ per km
Isolation Voltage Wire/Wire Wire/Shield	 1.5 kV 0.8 kV
Operating Voltage	Max. 30 V
Mechanical Characteristics	
Temperature Range Moving Static	 -10 °C to +80 °C -40 °C to +90 °C
Outer Diameter	6.5 mm ± 0.2 mm
Flex Radius	≥ 50 mm
Speed	≤ 4 m/s
Acceleration	< 60 m/s²
Flex Cycles	≥ 3,000,000
Weight	0.07 kg/m

Table 51: Technical data for resolver cables (Forts.)

4. Connectors

4.1 General Information

B&R offers five different motor/encoder connectors for 8MS three-phase synchronous motors. All connectors have IP67 protection. The metallic housing provides a protective ground connection on the housing according to VDE 0627. All plastic used in the connector is UL94/V0 listed. High quality, gold plated cage connector contacts guarantee a high level of contact security even when reinserted many times.

Information:

Using B&R connectors guarantees that the EMC limits for the connection are not exceeded. Make sure that connectors are put together correctly including a proper shield connection.

4.2 Motor Connectors

4.2.1 Order Data

Model Number	Short Description	Image
	Cable Diameter 9 - 17 mm	
8PM001.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 0.5-2.5mm^2 + 4 x 0.06-1.0mm^2, for cable ø 9-14mm, IP67, UL/CSA listed	
8PM002.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 2.5-4,0mm^2 + 4 x 0.06-1.0mm^2, for cable ø 14-17mm, IP67, UL/CSA listed	
	Cable Diameter 17 - 26 mm	
8PM003.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 1.5-10mm^2 + 4 x 0.5-2.5mm^2, for cable ø 17-26mm, IP67, UL/CSA listed	

Table 52: Order data for motor connectors

4.2.2 Technical Data for 8PM001.00-1 and 8PM002.00-1

Product ID	**8PM001.00-1**	**8PM002.00-1**
General Information		
Connector Size	Size 1	
Contacts	8 (4 power and 4 signal contacts)	
Degree of Pollution	3	
Installation Altitude	Up to 2,000 m	
Insulator	PA 6.6 / PBT, UL94/V0 listed	
Contacts	Gold plated brass	
Protective Ground Connection on Housing	According to VDE 0627	
Protection According to DIN 40050	IP67 when connected	
Certifications	UL/CSA	
Electrical Characteristics		
Overvoltage Category	3	
Power Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 30 A 630 VAC / VDC 6000 V < 3 mΩ	
Signal Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 10 A 250 VAC / VDC 2500 V < 5 mΩ	
Mechanical Characteristics		
Temperature Range	-20 °C to +130 °C	
Housing Material	Zinc die cast / brass, nickel plated	
Gaskets	FPM / HNBR	
Mating Cycles	> 50	
Crimp Range	4 x 0.5 - 2.5 mm² + 4 x 0.06 - 1 mm²	4 x 2.5 - 4 mm² + 4 x 0.06 - 1 mm²
Cable ø	9.5 - 14.5 mm	14 - 17 mm
Manufacturer Information		
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz	
Manufacturer’s Product ID	BSTA 108 FR 19 58 0036 000	BSTA 108 FR 35 59 0036 000

Table 53: Technical data for motor connectors 8PM001.00-1 and 8PM002.00-1

4.2.3 Technical Data for 8PM003.00-1

Product ID	**8PM003.00-1**
General Information	
Connector Size	Size 1.5
Contacts	8 (4 power and 4 signal contacts)
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection According to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Power Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 75 A 630 VAC / VDC 6000 V < 1 mΩ
Signal Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 30 A 630 VAC / VDC 4000 V < 3 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Magnesium die cast / aluminum, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	4 x 1.5 - 10 mm² + 4 x 0.5 - 2.5 mm²
Cable ø	17 - 26 mm
Manufacturer Information	
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz
Manufacturer’s Product ID	CSTA 264 FR 48 25 0001 000

Table 54: Technical data for motor connector 8PM003.00-1

4.3 Encoder Connectors

4.3.1 Order Data

Model Number	Short Description	Image
	EnDat Connector	
8PE001.00-1	EnDat Connector 17 pin Intercontec socket, crimp range 17 x 0.06-1,0mm², for cable ø 9-12mm, IP67, UL/CSA listed	
	Resolver Connector	
8PR001.00-1	Resolver connector 12 pin Intercontec socket, crimp range 12 x 0.06-1.0mm², for cable ø 5.5-10.5mm, IP67, UL/CSA listed	

Table 55: Order data for encoder connectors

4.3.2 Technical Data for EnDat connector 8PE001.00-1

Product ID	**8PE001.00-1**
General Information	
Connector Size	Size 1
Contacts	17 signal contacts
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection According to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Signal Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 9 A 125 V 2500 V < 5 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Zinc die cast / brass, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	17 x 0.06 - 1 mm²
Cable ø	9 - 12 mm
Manufacturer Information	
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz
Manufacturer's Product ID	ASTA 035 FR 11 12 0035 000

Table 56: Technical data for EnDat connector 8PE001.00-1

4.3.3 Technical Data for resolver connector 8PR001.00-1

Product ID	**8PR001.00-1**
General Information	
Connector Size	Size 1
Contacts	12 signal contacts
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection According to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Signal Contacts Rated Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	 9 A 160 V 2500 V < 5 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Zinc die cast / brass, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	12 x 0.06 - 1 mm^2
Cable ø	5.5 - 10.5 mm
Manufacturer Information	
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz
Manufacturer's Product ID	ASTA 021 FR 11 10 0035 000

Table 57: Technical data for resolver connector 8PR001.00-1

Chapter 3 • Installation

1. General Information

Make sure that installation takes place on a flat surface which is correctly dimensioned. The dimensional diagram lists the number and type of mounting screws to be used.

The eye bolt contained in the delivery can be attached to the device to lift ACOPOS 1640 and ACOPOS 128M drives:

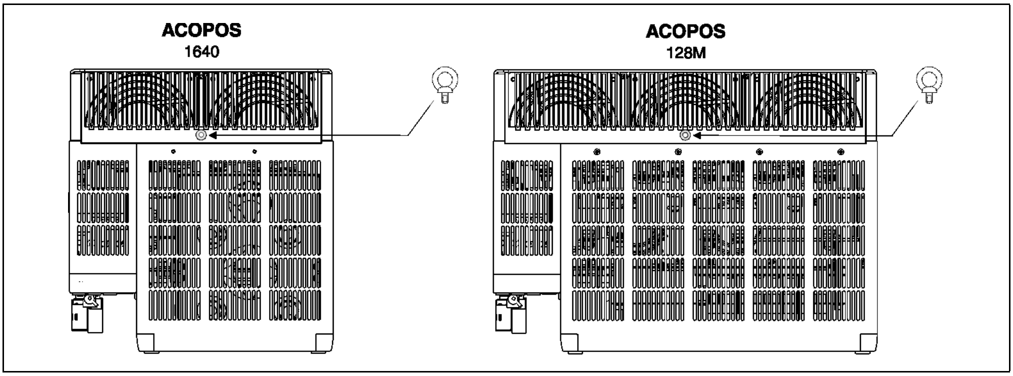


Figure 14: Attaching the eye bolt contained in the delivery to ACOPOS 1640, 128M drives

ACOPOS servo drives can only be installed in an environment which corresponds to pollution degree II (non-conductive material). When installing the device, make sure that the specifications for maximum operating temperature and protection level listed in the technical data are met (see section 2 "Technical Data" on page 33).

For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. ACOPOS servo drives can be mounted directly next to each other; the required distance between devices can be found in the respective dimensional diagram.

2. Dimension Diagrams and Installation Dimensions

2.1 ACOPOS 1010, 1016

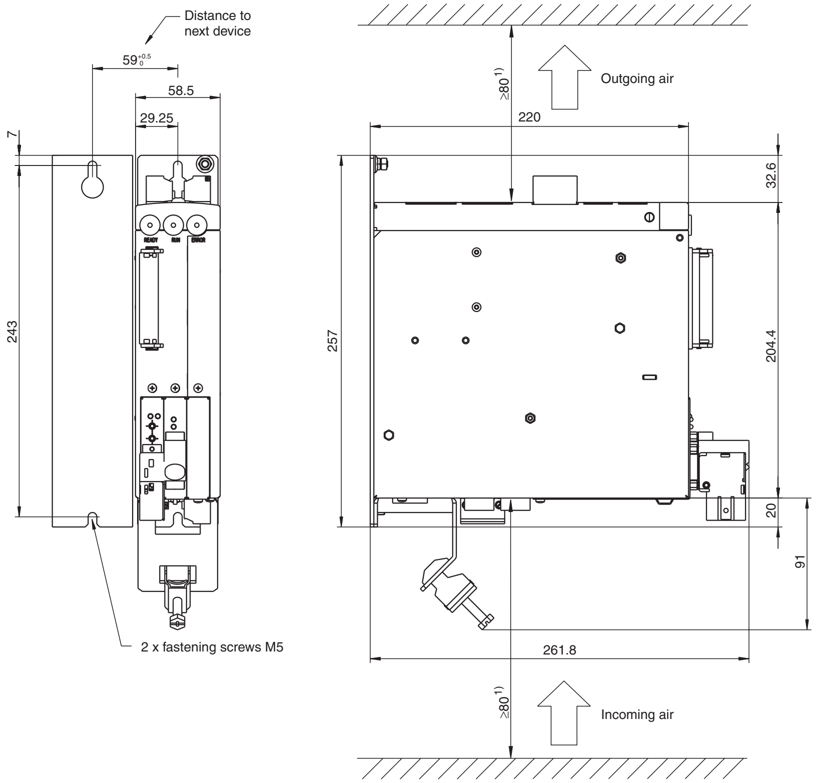

Distance to next device
59 +0.5 0
58.5
29.25
7
243
READY
RUN
ERROR
2 x fastening screws M5
≥80 1)
Outgoing air
220
32.6
257
204.4
20
91
261.8
≥80 1)
Incoming air

Figure 15: Dimensional diagram and installation dimensions for ACOPOS 1010, 1016

1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 100 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.2 ACOPOS 1022, 1045, 1090

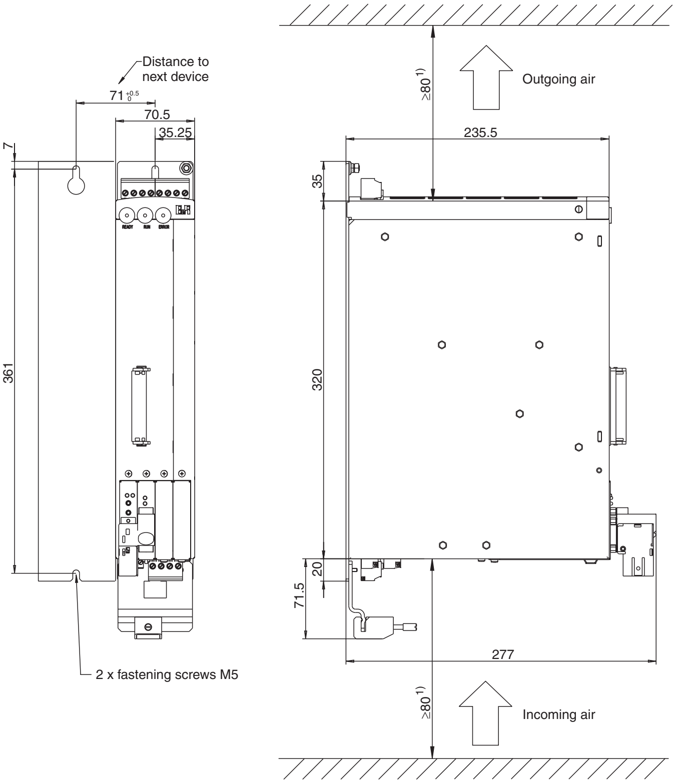

Distance to next device
71 +0.5 0
70.5
35.25
7
361
2 x fastening screws M5
READY RUN ERROR
≥80 1)
Outgoing air
235.5
35
320
20
71.5
277
≥80 1)
Incoming air

Figure 16: Dimensional diagram and installation dimensions for ACOPOS 1022, 1045, 1090

1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive.

2.3 ACOPOS 1180, 1320

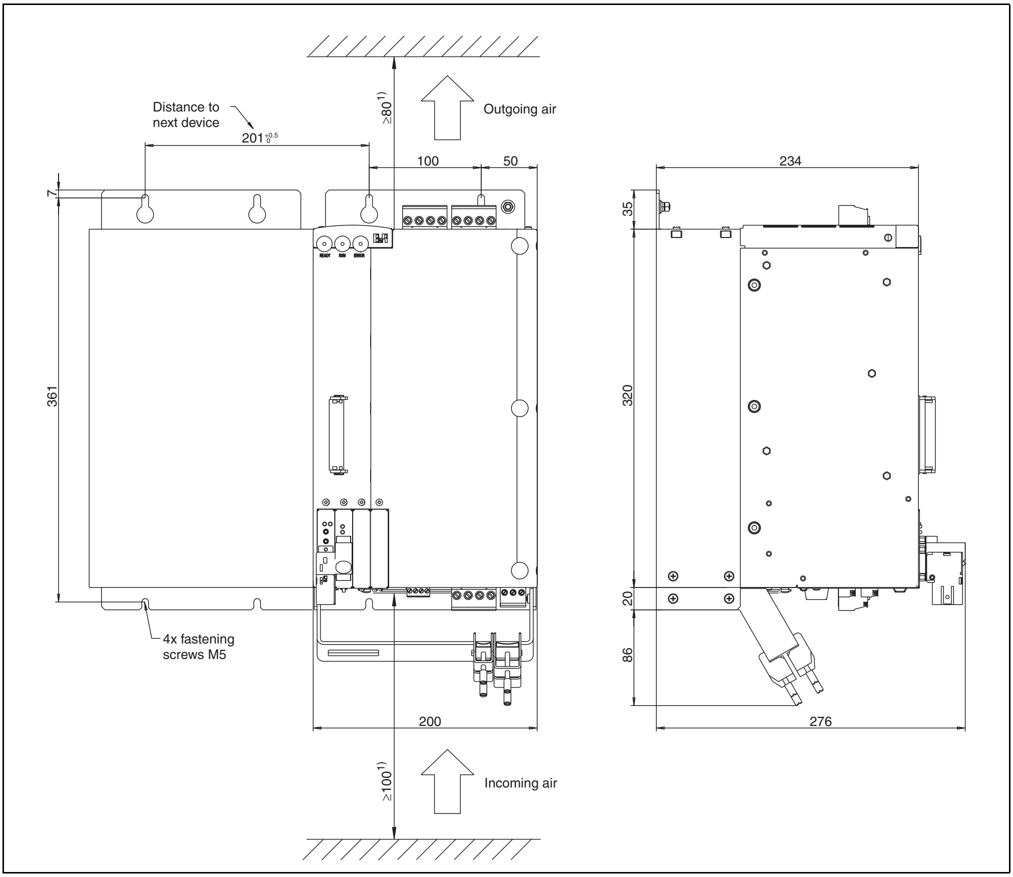

Distance to next device
201 +0.5 0
≥80 1)
Outgoing air
100
50
234
7
35
361
320
20
86
READY RUN ERROR
4x fastening screws M5
200
276
≥100 1)
Incoming air

Figure 17: Dimensional diagram and installation dimensions for ACOPOS 1180, 1320

1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 100 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.4 ACOPOS 1640

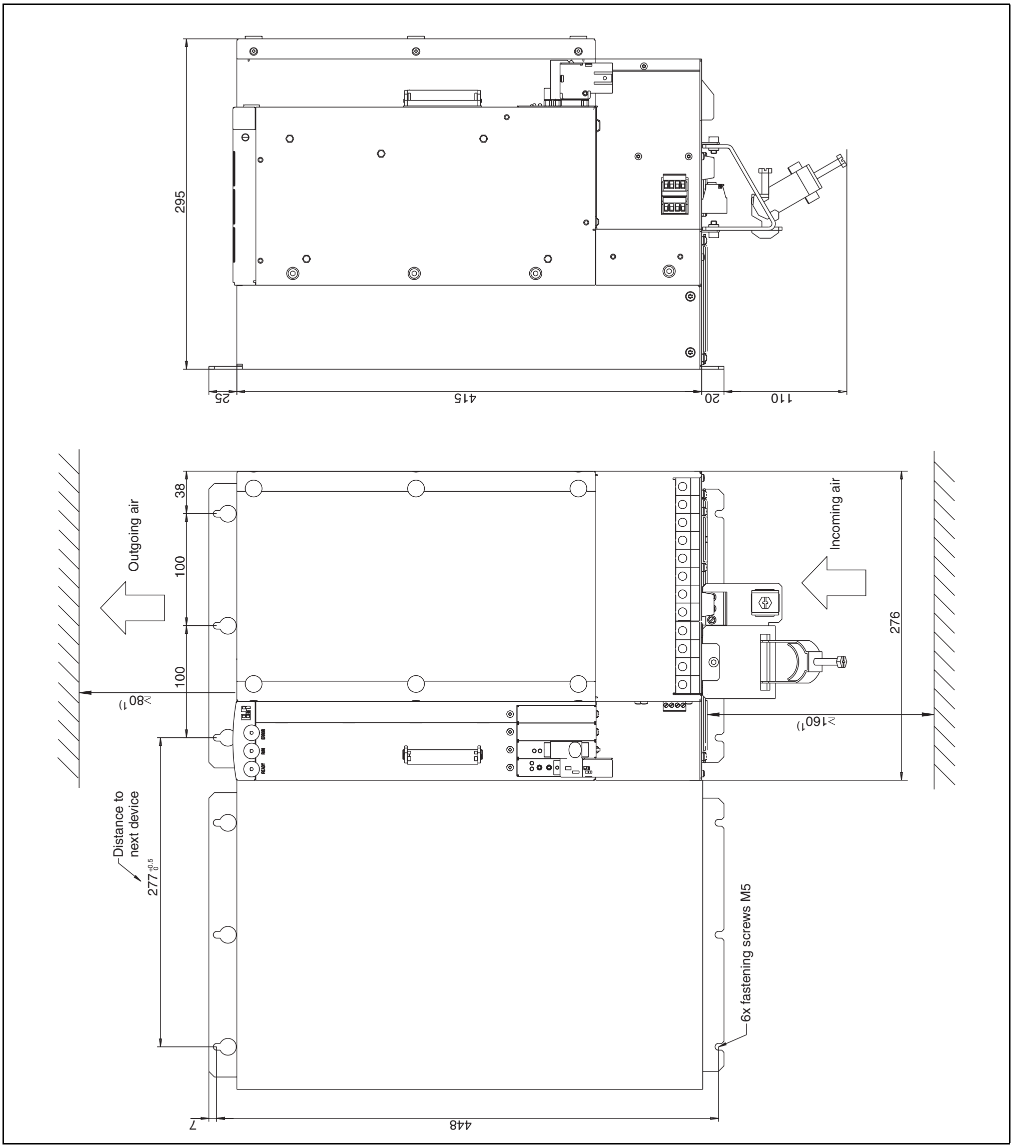

295
25
415
20
110
38
100
100
Outgoing air
Incoming air
≥80 1)
≥160 1)
276
Distance to next device
277 +0.5 0
6x fastening screws M5
7
448

Figure 18: Dimensional diagram and installation dimensions for ACOPOS 1640

1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 160 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.5 ACOPOS 128M

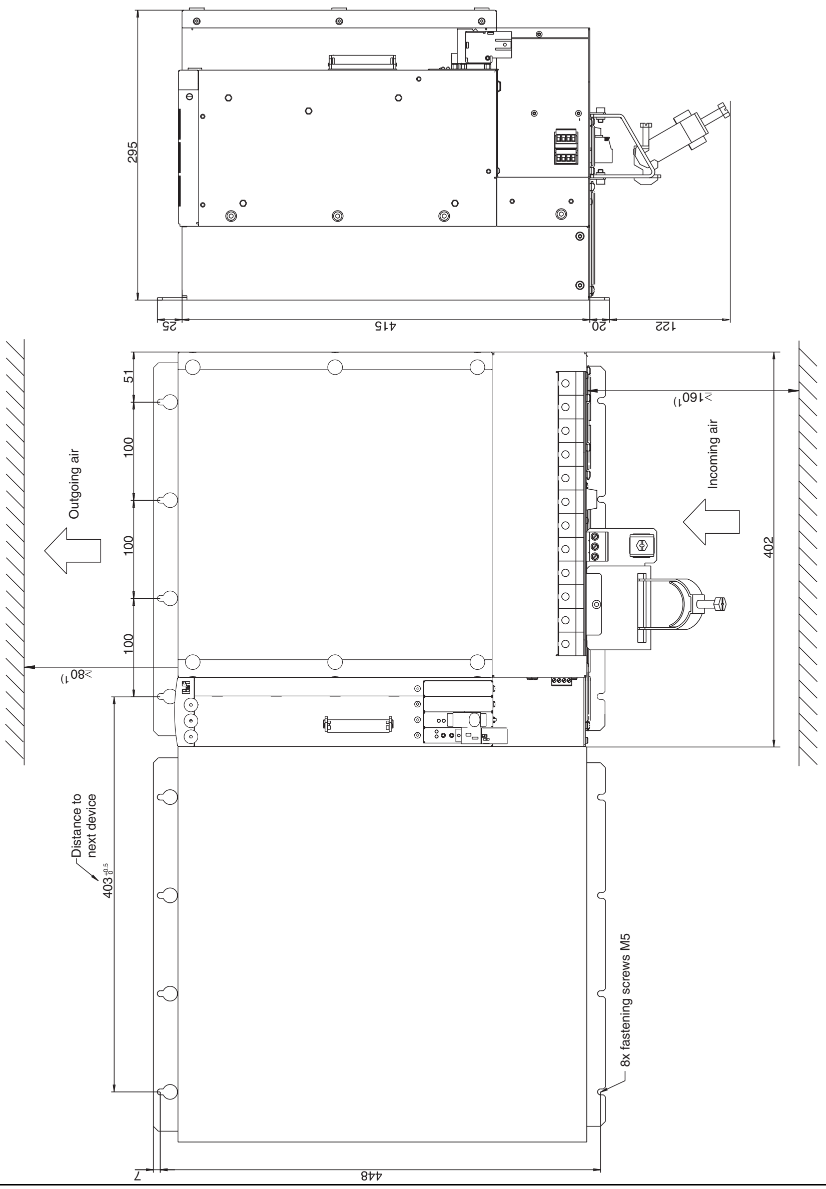

295
25
415
20
122
51
100
100
100
≥80 1)
≥160 1)
Outgoing air
Incoming air
402
Distance to next device
403 +0.5/0
8x fastening screws M5
7
448

Figure 19: Dimensional diagram and installation dimensions for ACOPOS 128M

1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 160 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

3. Installation and Removal of Plug-in Modules

3.1 General Information

All ACOPOS servo drives are equipped with three or four slots for plug-in modules depending on the size. At present, the following module arrangements must be used:

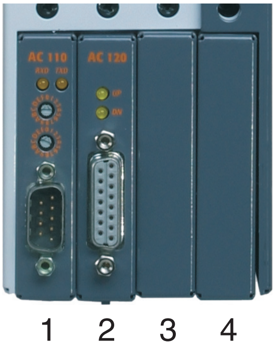
Image	Plug-in module	Operation possible in			
		Slot 1	Slot 2	Slot 3	Slot 4 [1]
	8AC110.60-2	Yes	No	No	No
	8AC112.60-1	Yes	No	No	No
	8AC120.60-1	No	Yes	Yes	Yes
	8AC122.60-2	No	Yes	Yes	Yes
	8AC123.60-1	No	Yes	Yes	Yes
	8AC130.60-1	No	Yes	Yes	Yes
	8AC131.60-1	No	Yes	Yes	Yes
	8AC140.60-1	Yes [2]	Yes [2]	No	No
	8AC140.61-2	Yes [2]	Yes [2]	No	No

Table 58: Slot overview for ACOPOS plug-in modules

1) Not available for ACOPOS servo drives 8V1010.00-2, 8V1010.50-2, 8V1016.00-2 and 8V1016.50-2.

2) The module uses two slots.

Caution!

- **Keep the plug-in modules in the original packaging and only take them out immediately before installation.**
- **Avoid touching the plug-in modules anywhere but on the front cover.**
- **Take the necessary steps to protect against electrostatic discharges.**

3.2 Installation

1) Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.

2) Switch off 24 VDC supply voltage.

3) Remove screw from the bottom of the slot cover.

4) Loosen screw on the front side.

5) Remove slot cover.

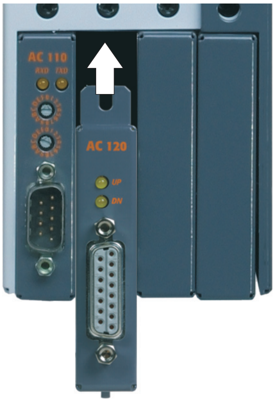


Figure 20: Installing ACOPOS plug-in modules

6) Insert plug-in module in the free slot (see figure shown above).

7) Fasten the plug-in module with the two screws.

8) Switch on 24 VDC supply voltage.

9) Connect ACOPOS servo drive to the power mains.

3.3 Removal

1) Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.

2) Switch off 24 VDC supply voltage.

3) Remove screw from the bottom of the plug-in module.

4) Loosen the screw on the front side of the plug-in module.

5) Remove plug-in module.

6) Insert slot cover in free slot.

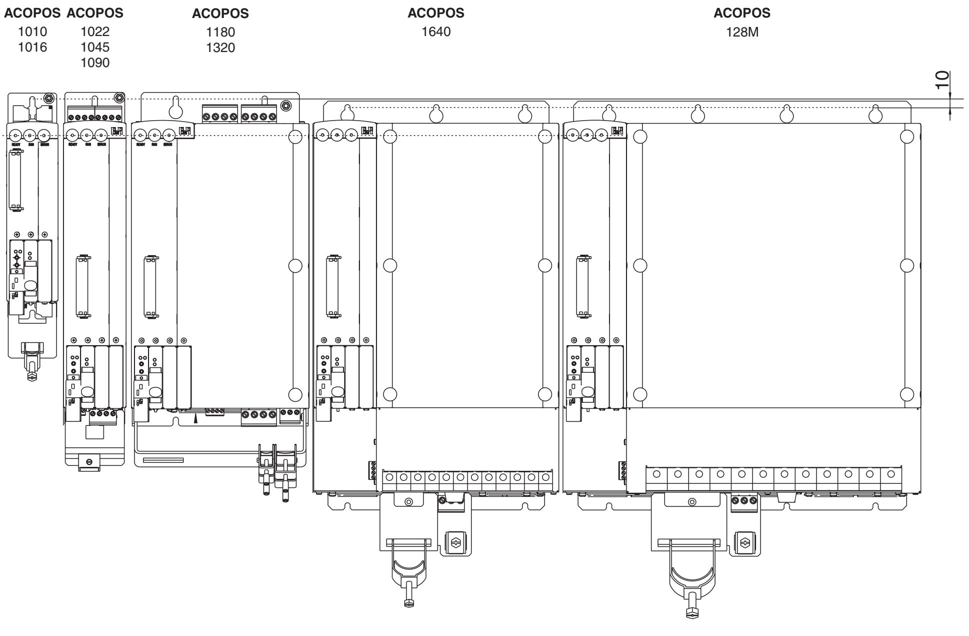
7) Fasten the slot cover with the two screws.

8) Switch on 24 VDC supply voltage.

9) Connect ACOPOS servo drive to the power mains.

4. Installing Various ACOPOS Series Devices Directly Next to Each Other

When installing various ACOPOS series devices directly next to each other, we recommend aligning the vertical position so that the LED displays of the respective devices are lined up.



❶ Vertical displacement of the position of the upper mounting holes

Figure 21: Installing various ACOPOS series devices directly next to each other

You can see from the image above that the vertical offset of the upper mounting holes is 10 mm. The distances for the lower mounting holes and the number and size of the screws required can be taken from the dimensional diagrams for the respective ACOPOS servo drives.

Overview of the vertical offsets:

<table>
<tr><th colspan="2" rowspan="2">Installed next to</th><th colspan="9">ACOPOS</th></tr>
<tr><th>1010</th><th>1016</th><th>1022</th><th>1045</th><th>1090</th><th>1180</th><th>1320</th><th>1640</th><th>128M</th></tr>
<tr><th rowspan="9">ACOPOS</th><th>1010</th><td colspan="7" rowspan="7">No offset</td><td colspan="2" rowspan="7">10 mm</td></tr>
<tr><th>1016</th></tr>
<tr><th>1022</th></tr>
<tr><th>1045</th></tr>
<tr><th>1090</th></tr>
<tr><th>1180</th></tr>
<tr><th>1320</th></tr>
<tr><th>1640</th><td colspan="7" rowspan="2">10 mm</td><td colspan="2" rowspan="2">No offset</td></tr>
<tr><th>128M</th></tr>
</table>

Table 59: Overview of the vertical offsets (ACOPOS - ACOPOS)

5. Using Cooling Aggregates in Switching Cabinets

5.1 General Information

To prevent exceeding the required environmental temperatures, it may be necessary to cool the air inside of a switching cabinet.

> ### Caution!
>
> **Incorrect installation of cooling aggregates may cause condensation which can damage the ACOPOS servo drives installed there!**
>
> **Condensation can enter the ACOPOS servo drives with the cooled air stream!**

Make sure that only well sealed switching cabinets are used (condensation caused by outside air entering the switching cabinet).

During operation with the switching cabinet doors open (e.g. service), the ACOPOS servo drives are not allowed to be cooler than the air in the switching cabinet at any time after the doors are closed.

To keep the temperature of the ACOPOS servo drives and the switching cabinet at the same level, the cooling aggregate must remain in operation even when the system is switched off.

Cooling aggregates must be installed in a way that prevents condensation from dripping into the ACOPOS servo drives. This should be considered when selecting the switching cabinet (special construction for use of cooling aggregates on top of the switching cabinet).

Also make sure that condensed water which forms in the cooling aggregate fan when it is switched off cannot sprinkle into the ACOPOS servo drives.

Make sure the temperature setting of the cooling aggregates is correct!

5.2 Placing a Cooling Aggregate on Top of the Switching Cabinet

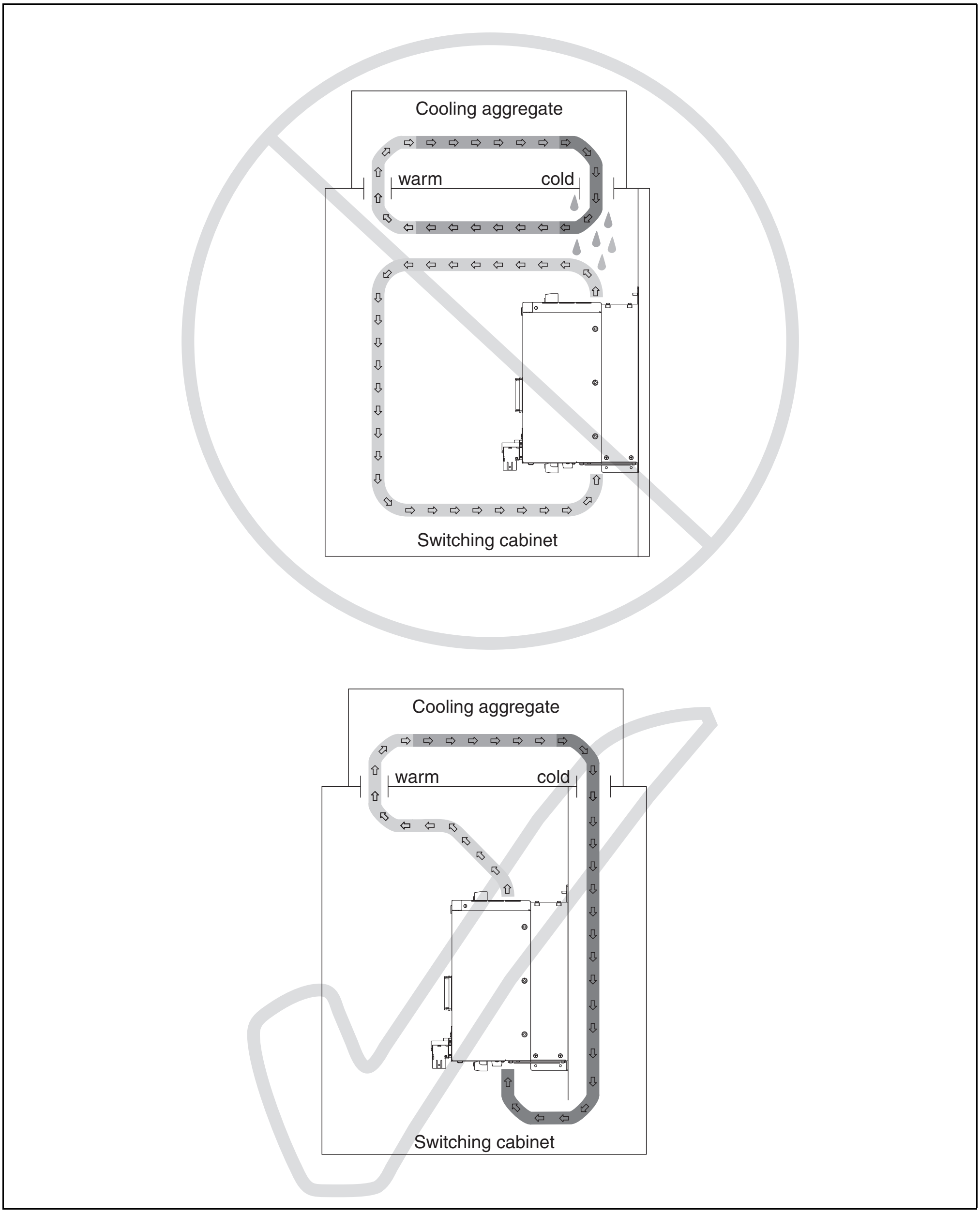

Cooling aggregate
warm
cold
Switching cabinet
Cooling aggregate
warm
cold
Switching cabinet

Figure 22: Placing a cooling aggregate on top of the switching cabinet

5.3 Placing a Cooling Aggregate on the Front of the Switching Cabinet

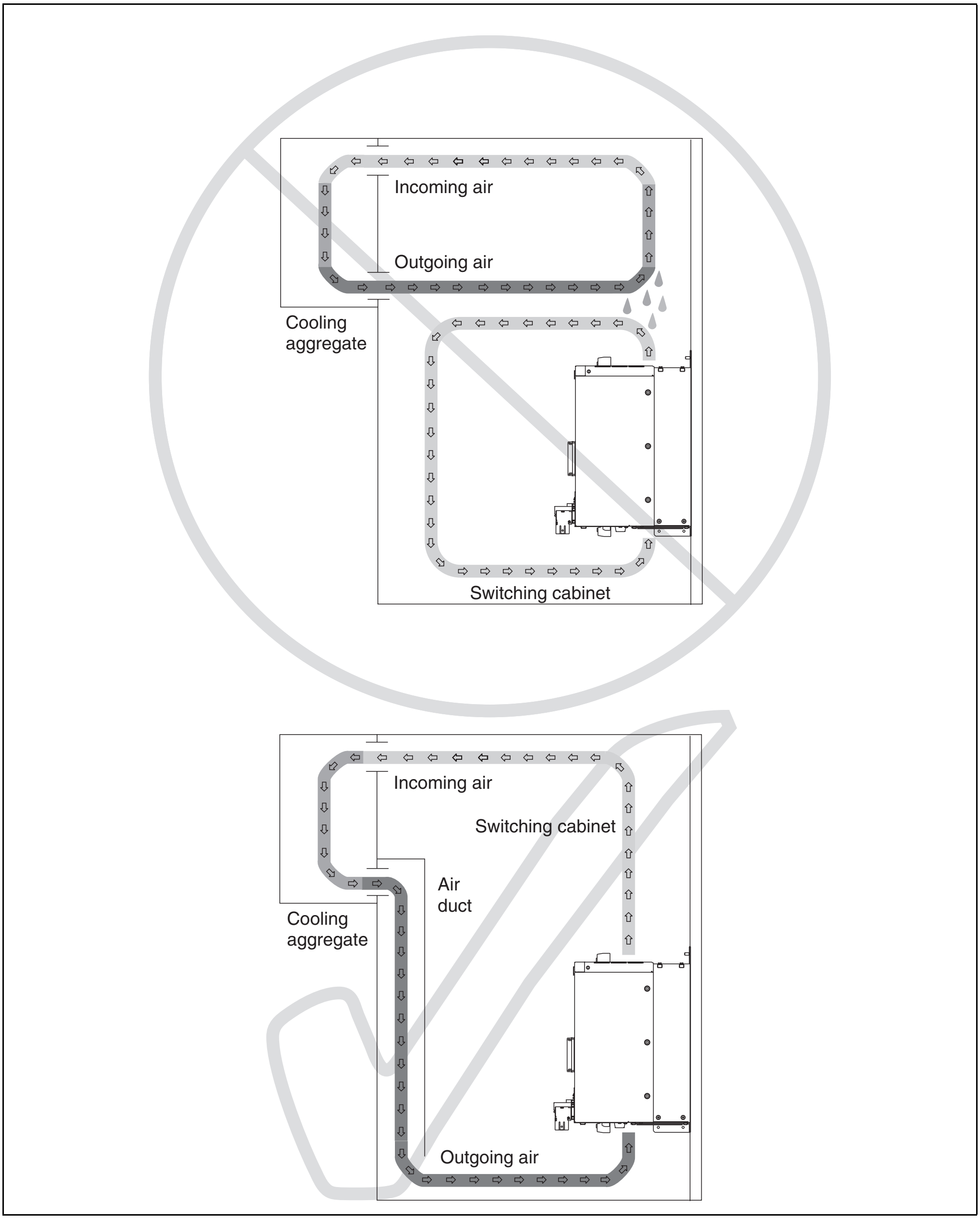

Incoming air
Outgoing air
Cooling aggregate
Switching cabinet
Incoming air
Switching cabinet
Air duct
Cooling aggregate
Outgoing air

Figure 23: Placing a cooling aggregate on the front of the switching cabinet

Chapter 4 • Dimensioning

1. Power Mains Connection

1.1 General Information

1.1.1 System Configuration

The power mains connection is made using terminals X3 / L1, L2, L3 and PE. The ACOPOS servo drives can be directly connected to TT and TN systems (these are three-phase systems with grounded neutral).

When using ungrounded IT mains (three-phase systems without grounded neutral) or TN-S mains with grounded phase conductor and protective ground conductor, isolation transformers must be used. The secondary neutral must be grounded and connected to the ACOPOS protective ground conductor. In this way, it is possible to prevent over-voltages between external conductors and the ACOPOS housing. Three-phase isolation transformers with the corresponding input and output voltages and a vector group with secondary neutral can be used (e.g. 3 x 400 V / 3 x 400 V, Dyn5).

> **Danger!**
>
> **The ACOPOS servo drives are only allowed to be operated directly on grounded, three-phase industrial mains (TN, TT systems). When using the servo drives in living areas, shops and small businesses, additional filtering measures must be implemented by the user.**

> **Danger!**
>
> **Servo drives are not allowed to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!**

1.1.2 Supply Voltage Range

The supply voltage range permitted for ACOPOS servo drives can be found in the following table:

	8V1010.50-2 8V1016.50-2	8V1010.00-2 8V1016.00-2	8V1022.00-2 8V1045.00-2 8V1090.00-2	8V1180.00-2 8V1320.00-2	8V1640.00-2 8V128M.00-2
Mains Input Voltage	3 x 110 VAC to 230 VAC ±10 % or 1 x 110 VAC to 230 VAC ±10 %	3 x 400 VAC to 480 VAC ±10 %			

Table 60: Supply Voltage Range for ACOPOS Servo Drives

Respective intermediate transformers must be used for other supply voltages. With grounded power mains, autotransformers can also be used to adjust the voltage. Neutral does not have to be connected for this type of transformer.

1.1.3 Protective Ground Connection (PE)

The following information concerning the protective ground connection corresponds to IEC 61800-5 (draft), Item 3.2.5.3 "Connection elements for the protective ground conductor" and must be followed.

Wire Cross Section

The wire cross section for the protective ground conductor is oriented to the external conductors and must be selected according to the following table:

Wire Cross Section for External Line A [mm²]	Minimum Wire Cross Section for Protective Ground Connection A_{PE} [mm²]
$A \leq 16$	A
$16 < A \leq 35$	16
$35 < A$	A / 2

Table 61: Selection of the protective ground conductor cross section

Increased Discharge Current

ACOPOS servo drives are devices with increased discharge current (larger than 3.5 mA AC or 10 mA DC). Therefore a fixed (immobile) protective ground connection is required on the servo drives.

The following conditions must be met, depending on the ACOPOS device being used:

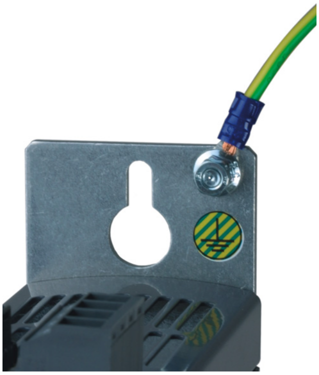
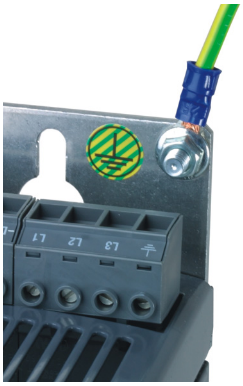
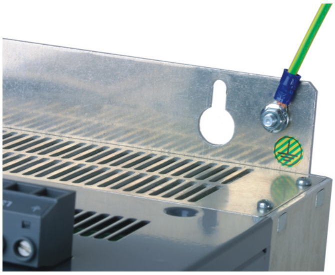
ACOPOS	Conditions	Image
1010 1016	In addition to the connection of the first protective ground conductor on terminal X3 / PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (threaded bolt M5).	
1022 1045 1090	In addition to the connection of the first protective ground conductor on terminal X3 / PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (threaded bolt M5).	
1180 1320	In addition to the connection of the first protective ground conductor on terminal X3 / PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (threaded bolt M5).	
1640 128M	The cross section of the protective ground conductor connected to terminal X3 / PE must be at least 10 mm² Cu.	

Table 62: Protective ground conditions according to ACOPOS device

1.2 Dimensioning

In general, dimensioning the power mains, the over-current protection and the line contactors depend on the structure of the power mains connection. The ACOPOS servo drives can be connected individually (each drive has separate over-current protection and, if necessary, a separate line contactor) or together in groups.

1.2.1 Individual ACOPOS Power Mains Connections

The structure of an individual power mains connection with line contactor and circuit breaker can be seen in the following diagram:

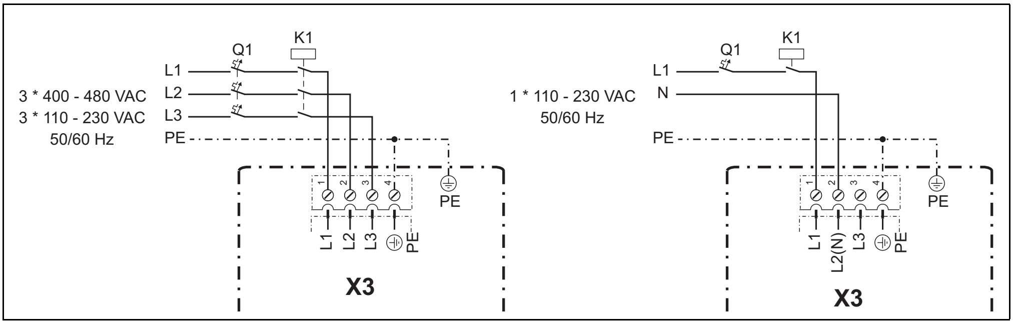


Figure 24: Circuit diagram for ACOPOS X3, individual power mains connection

Dimensioning the Power Mains and Over-current Protection

The cross section of the power mains and the rated current for over-current protection should be dimensioned for the average current load to be expected.

The power mains are to be equipped with over-current protection in the form of a circuit breaker or a fuse. Circuit breakers (time lag) with type C tripping characteristics (according to IEC 60898) or fuses (time lag) with type gM tripping characteristics (according to IEC 60269-1) are to be used. [1]

The average current load to be expected can be calculated as follows:

$$I_{mains}[A] = \frac{S[VA]}{\sqrt{3} \cdot U_{mains}[V]}$$

---

[1] Circuit breakers are available on the market with rated currents from 6 A to 63 A.
Outside of this range, fuses must be used.

The apparent power S can be calculated as follows: [1]

$$S[VA] = M_{eff}[Nm] \cdot k \cdot \frac{2 \cdot \pi \cdot n_{aver}[min^{-1}]}{60}$$

The constant k for each of the various ACOPOS servo drives can be taken from the following table:

Description	**ACOPOS**								
	1010	**1016**	**1022**	**1045**	**1090**	**1180**	**1320**	**1640**	**128M**
Constant k	In preparation		2.8	2.4		2.1	1.9	1.7	1.5

Table 63: Constant k

The cross section of the power mains and the rated current of the over-current protection used are chosen according to table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126 so that the maximum current load for the cable cross section selected is greater than or equal to the calculated mains current.

$$I_Z \geq I_{mains}$$

The rated current of the over-current protection must be less than or equal to the maximum current load for the cable cross section selected (see table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126).

$$I_B \leq I_Z$$

---

1) If information concerning load torque, inertia and friction are available, the effective torque is calculated according to the following formula:

$$M_{eff}[Nm] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_i M_i[Nm]^2 \cdot t_i[s]}$$

To calculate n_{aver}, information concerning the positioning cycle must be available.
n_{aver} is calculated using the following formula:

$$n_{aver}[min^{-1}] = \frac{1}{T_{cycle}[s]} \cdot \sum_i n_i[min^{-1}] \cdot t_i[s]$$

The following table shows the maximum current load of PVC insulated three-phase cables (or three current-carrying wires) according to IEC 60204-1 at 40 °C environmental temperature [1] and 70 °C maximum conductor temperature (maximum current load for installation type F and cross sections greater than 35 mm², IEC 60364-5-523 is used for installation types B1 and B2).

Line cross section [mm²]	Maximum current load for the cable cross section I_Z / rated current for the over-current protection I_R [A] depending on the type of installation				
	Three individual wires in insulating conduit or cable duct B1	Three-phase cable in insulating conduit or cable duct B2	Three-phase cable on walls C	Three-phase cable in a cable tray E	Three individual wires in a cable tray F
1.5	13.5 / 13	12.2 / 10	15.2 / 13	16.1 / 16	---
2.5	18.3 / 16	16.5 /16	21 / 20	22 / 20	---
4	25 / 25	23 / 20	28 / 25	30 / 25	---
6	32 / 32	29 / 25	36 / 32	37 / 32	---
10	44 / 32	40 / 32	50 / 50	52 / 50	---
16	60 / 50	53 / 50	66 / 63	70 / 63	---
25	77 / 63	67 / 63	84 / 80	88 / 80	96 / 80
35	97 / 80	83 / 80	104 / 100	114 / 100	119 / 100
50	117 / 100	103 / 100	123 / 100	123 / 100	145 / 125
70	149 / 125	130 / 125	155 / 125	155 / 125	188 / 160
95	180 / 160	156 / 125	192 / 160	192 / 160	230 / 200

Table 64: Maximum current load for PVC insulated three-phase cables or individual wires

When determining the cross section for the power mains, make sure that the cross section selected is within the range that can be used with power mains terminal X3 (see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165).

Dimensioning the Line Contactor

The rated current of the line contactor is oriented to the over-current protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 is approximately 1.3 times the rated current of the over-current protection.

---

1) The maximum current load value in IEC 60204-1 is for an environmental temperature of 40 °C. In IEC 60364-5-523, this reference temperature is 30 °C. The values in table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126 from IEC 60364-5-523 are calculated with the factor k_{Temp} = 0.87 given in the standard and also at 40 °C.

1.2.2 Implementing ACOPOS Power Mains Connections for Drive Groups

The structure of the power mains connection for a drive group with line contactor and circuit breaker can be seen in the following diagram:

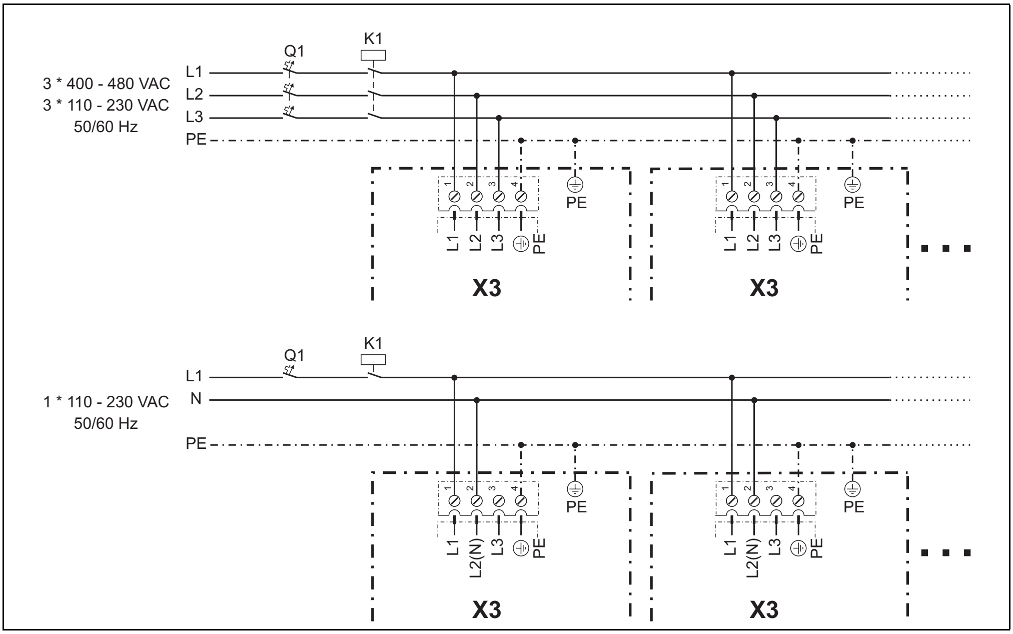


Figure 25: Circuit diagram for ACOPOS X3, power mains connection for a drive group

Dimensioning the Power Mains and Over-current Protection

The cross section of the distribution point and all power mains connections are chosen according to table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126 so that the maximum current load for the cable cross section selected [1] is greater than or equal to the sum of the calculated mains current.

$$I_Z \geq \sum I_{mains}$$

The rated current of the over-current protection must be less than or equal to the maximum current load for the cable cross section selected (see table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126).

$$I_B \leq I_Z$$

---

1) When determining a common cross section for several drives (especially with different sized ACOPOS modules), make sure that the cross section selected is within the range that can be used with the power mains terminals (see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165).

Dimensioning the Line Contactor

The rated current of a common line contactor is oriented to the over-current protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 is approximately 1.3 times the rated current of the over-current protection.

1.3 Fault Current Protection

Fault current protection (RCD - residual current-operated protective device) can be used with ACOPOS servo drives. However the following points must be noted:

ACOPOS servo drives have a power rectifier. If a short-circuit to the frame occurs, a flat DC fault current can be created which prevents an AC current or pulse current sensitive RCD (Type A or AC) from being activated, therefore canceling the protective function for all connected devices.

> **Danger!**
>
> **If used for protection during direct or indirect contact of the fault current protection (RCD), only a Type B RCD (AC-DC sensitive, according to IEC 60755) can be used for the ACOPOS power mains connection. Otherwise additional protective measures must be used, such as neutralization or isolation from the power mains using an isolation transformer.**

1.3.1 Rated Fault Current

On ACOPOS servo drives, fault current protection with a rated fault current 1) of ≥ 100 mA can be used. However, errors can occur:

- When connecting servo drives to the power mains (short-term single-phase or two-phase operation because of contact chatter on the line contactor).
- Because of high frequency discharge currents occurring during operation when using long motor cables.
- Because of an extreme unbalance factor for the three-phase system.

---

1) The rated fault current listed by the manufacturer are maximum values which will definitely trip the protective device. Normally, the protective device is tripped at approximately 60 % of the rated fault current.

1.3.2 Estimating the Discharge Current

Depending on the connection of the ACOPOS servo drive, different discharge currents flow to ground on the protective ground conductor (PE):

Single-phase or two-phase operation (as intermediate state when switching on the line contactor):

$$I_D[A] = \frac{U_{mains}[V] \cdot 2 \cdot \pi \cdot f_{mains}[Hz] \cdot C_D[F]}{\sqrt{3}}$$

Single-phase operation with neutral line:

$$I_D[A] = \frac{U_{mains}[V] \cdot 2 \cdot \pi \cdot f_{mains}[Hz] \cdot C_D[F]}{2 \cdot \sqrt{3}}$$

The discharge capacitance C_D the various ACOPOS servo drives can be taken from the following table:

Description	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128M
Discharge capacitance C_D	In preparation		660 nF			3.1 µF		5.4 µF	

Table 65: Discharge capacitance C_D

1.3.3 Manufacturer Used

For example, the AC-DC sensitive, 4 pole fault current protective device F 804 from ABB (fault current: 300 mA; nominal current: 63 A) can be used. Using this fault current protective device, approximately 5 ACOPOS 1022 (or 1045, 1090) can be connected in parallel.

2. DC Bus

2.1 General Information

With ACOPOS servo drives, it is possible to connect several servo drives via the DC bus. This connection allows compensation of braking and drive energy of several axes or the distribution of braking energy to several braking resistors.

The connection is made using terminals X2 / +DC and -DC. The structure of the DC bus connections can be seen in the following diagram:

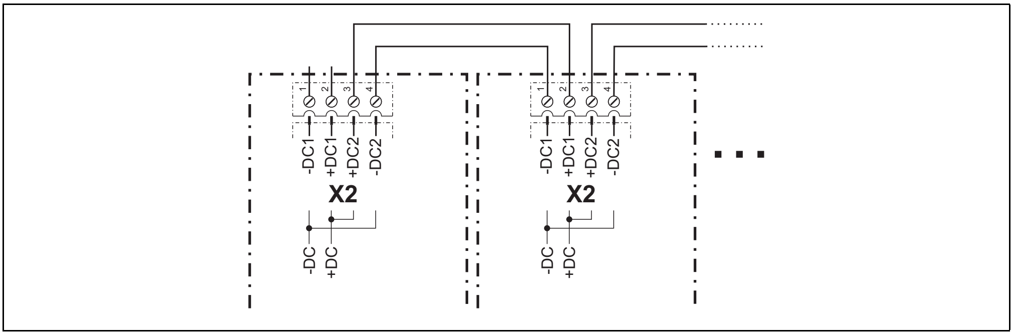


Figure 26: ACOPOS X2 circuit diagram, DC bus connections

Caution!

To prevent excessively high discharge currents from flowing over the individual servo drives, make sure that smaller servo drives are not connected between two larger servo drives.

Warning!

Its only permitted to link DC buses for ACOPOS servo drives with the same supply voltage range (see table 60 "Supply Voltage Range for ACOPOS Servo Drives" on page 122).

Therefore, the DC buses for ACOPOS servo drives 8Vxxxx.50-2 and 8Vxxxx.00-2 are not allowed to be linked! For this reason, the X2 plugs for ACOPOS servo drives 8Vxxxx.50-2 and 8Vxxxx.00-2 are coded differently.

2.2 Wiring

The DC bus connections on the ACOPOS servo drives do **not** have short circuit and ground fault protection and are not protected against reverse polarity. Therefore the DC bus connections must be wired correctly.

> ## Caution!
>
> **The DC bus connections must be wired correctly (no short circuits, ground faults or reverse polarity).**

A suitable measure to ensure that the wiring is secure against short circuits and ground faults 1) is the use of corresponding cabling. Special rubber-insulated wires with increased resistance to heat (90 °C) of types

- NSGAÖU
- NSGAFÖU
- NSGAFCMÖU

with a nominal voltage U_0/U of at least 1.7/3 kV are considered to be secure against short circuits and ground faults in switchgear and distribution systems up to 1000 V 2) .

---

1) Cabling e.g. according to DIN VDE 0100, part 200 "Electrical systems for buildings - terms", item A.7.6.

2) See e.g. DIN VDE 0298, part 3 "Use of cables and insulated wires for high-voltage systems", item 9.2.8.

2.3 Equal Distribution of the Applied Power via the Power Rectifiers

When creating a DC bus connection between several servo drives, it is possible that the parallel connection of the power rectifiers causes incorrect distribution of the applied power. To prevent this undesired effect, appropriately dimensioned balancing resistors are integrated in the ACOPOS servo drives.

The following rules must be observed so that the effect of these balancing resistors is not cancelled out:

- The length of the DC bus wiring is not allowed to exceed a total length of 3 m and must be within a single switching cabinet.
- Dimensioning the cross section of the ACOPOS servo drive power mains must be done according to section "Dimensioning the Power Mains and Over-current Protection", on page 124.
- The cross section of the DC bus wiring 1) on the respective ACOPOS servo drives must be less than or equal to the cross section of the servo drive power mains.
- The selected cross section must be within the range possible for the DC bus connection terminal X2 (see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165).

2.4 Equal Distribution of the Brake Power on the Braking Resistors

The braking resistors integrated in the ACOPOS servo drives as well as braking resistors which can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

When using the integrated braking resistors, additional configuration is not required.
When using external braking resistors, the corresponding parameters must be defined (see section 4.4 "Setting Brake Resistor Parameters" on page 141).

---

1) The cross section of the individual segments of the DC bus wiring must be dimensioned for the thermal equivalent effective value of the respective compensation current. If information concerning the flow of the compensation current is available, calculate the thermal equivalent effective value of the compensation current using

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The cross section of the DC bus connection should then also be selected as described in table 74 "Terminal cross sections for ACOPOS servo drives" on page 165, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the compensation current ($I_Z \geq I_q$).

2.5 Connection of External DC Bus Power Supplies

The ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy that occurs when braking is returned to the DC bus and the DC bus power supply can use it to create the 24 VDC supply voltage. In this way, the ACOPOS servo drives as well as encoders, sensors and possible safety circuit can be supplied with 24 VDC while braking. [1]

An external DC bus power supply must be used for ACOPOS servo drives 8V1010 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M.

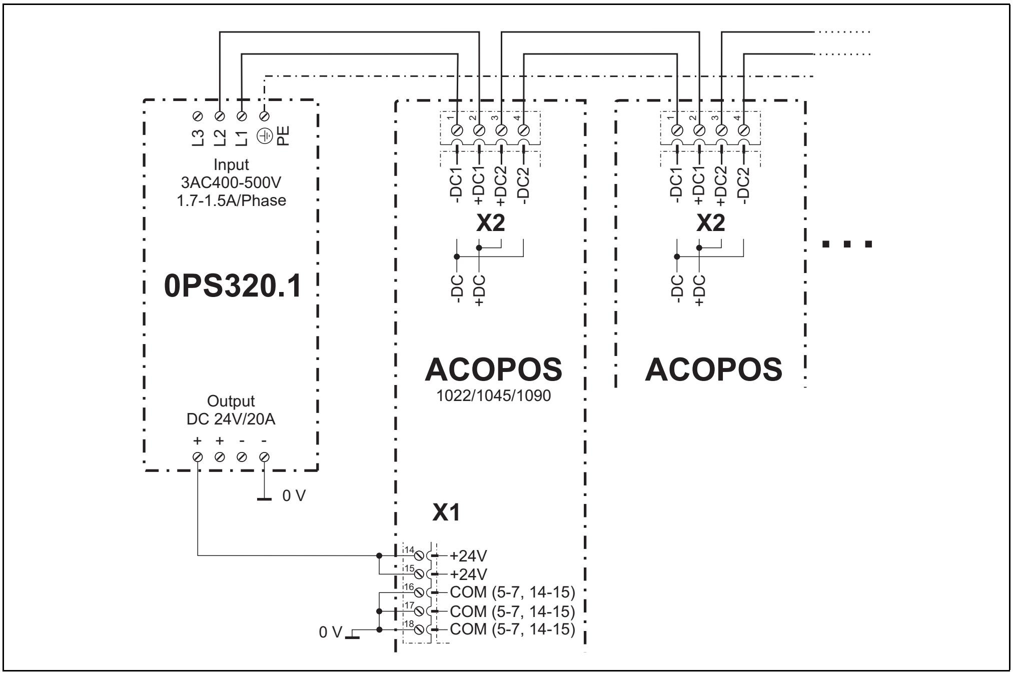

L3
L2
L1
PE
Input
3AC400-500V
1.7-1.5A/Phase
0PS320.1
Output
DC 24V/20A
+ + - -
0 V
1 2 3 4
-DC1
+DC1
+DC2
-DC2
X2
-DC
+DC
ACOPOS
1022/1045/1090
X1
14 +24V
15 +24V
16 COM (5-7, 14-15)
17 COM (5-7, 14-15)
18 COM (5-7, 14-15)
0 V
-DC1
+DC1
+DC2
-DC2
X2
-DC
+DC
ACOPOS

Figure 27: B&R power supply 0PS320.1 as DC bus power supply for ACOPOS servo drives

---

[1] WARNING: In some applications, there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.

3. Motor Connection

On B&R motors, the power connections, the connections for the holding brake and the connections for the motor temperature sensor are all made using the same motor plug.
On the servo drive, the motor connection is made using terminals X5 / U, V, W and PE as well as terminals X4b / B+, B-, T+ and T-. The motor connection must be shielded correctly (see section 1.1 "Electromagnetic Compatibility of the Installation" on page 147).

The structure of the motor connection can be seen in the following diagram:

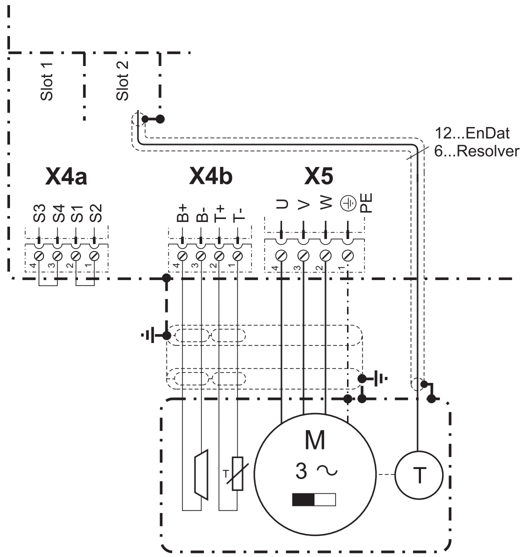


Figure 28: ACOPOS X4/X5 circuit diagram, motor connection

The cross section of the motor cable must be dimensioned for the thermal equivalent effective value of the motor current. 1)

The cross section of the motor cable is chosen for B&R motor cables according to the following table so that the maximum current load for the cable cross section selected is greater than or equal to the thermal equivalent effective value of the motor current:

$$I_Z \geq I_q$$

---

1) If information concerning load torque, inertia and friction are available, the thermal equivalent effective value for the motor current of the motor used is calculated as follows:

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The following table shows the maximum current load for special insulated three-phase cables according to IEC 60364-5-523 at 40 °C environmental temperature [1] and 90 °C maximum cable temperature.

Line cross section [mm²]	Maximum current load on the line I_Z [A] depending on type of installation		
	Three-phase cable in insulating conduit or cable duct B2	Three-phase cable on walls C	Three-phase cable in a cable tray E
1.5	17.8	20	20.9
4	31.9	36.4	38.2
10	54.6	64.6	68.3
35	116.5	133.8	143.8

Table 66: Maximum current load for special insulated three-phase cables

When determining the cross section for the motor cable, make sure that the cross section selected is within the range that can be used with motor connection terminal X5 (see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165).

---

1) The entry for the maximum current load in IEC 60364-5-523 is for an environmental temperature of 30 °C. The values in table 66 "Maximum current load for special insulated three-phase cables" on page 135 are calculated with the factor k_{Temp} = 0.91 given in the standard for use at 40 °C environmental temperature.

4. Braking Resistor

4.1 General Information

When braking servo motors, power is returned to the servo drive. This causes the capacitors in the DC bus to be charged to higher voltages. Starting with a DC bus voltage of approx. 800 V, the ACOPOS servo drive links the braking resistor to the DC bus using the brake chopper and converts the braking energy to heat.

For ACOPOS servo drives, braking resistors are integrated for this purpose or external braking resistors can be connected. The equipment differences can be found in the following table:

Description	**ACOPOS**								
	1010	**1016**	**1022**	**1045**	**1090**	**1180**	**1320**	**1640**	**128M**
DC Bus Capacitance	165 µF [1] 2040 µF [2]		235 µF		470 µF	940 µF	1645 µF	3300 µF	6600 µF
Integrated Brake Chopper	Yes								
Internal Braking Resistor			Yes	Yes		Yes		Yes [3]	Yes [3]
Continuous power output	In preparation		130 W	200 W		400 W		200 W	240 W
Maximum Power	2 kW		3.5 kW	7 kW		14 kW		7 kW	8.5 kW
Connection of External Braking Resistor Possible [4]	No [6]					Yes		Yes	
Continuous power output	---					8 kW		24 kW	
Maximum Power	---					40 kW		250 kW	
Minimum braking resistance (R_{Brmin})	---					15 Ω		2,5 Ω	
Rated current for the built-in fuse (I_B) [5]	---					10 A (fast-acting)		30 A (fast-acting)	

Table 67: Braking resistors for ACOPOS servo drives

1) For 8V1010.00-2 and 8V1016.00-2.
2) For 8V1010.50-2 and 8V1016.50-2.
3) The braking resistor integrated in the ACOPOS servo drives 1640 and 128M is dimensioned so that it is possible to brake to a stop (in a typical drive situation).
4) The ACOPOS servo drives are designed so that either the integrated braking resistor **or** the external braking resistor can be activated. Braking with both braking resistors at the same time is not possible.
   Switching takes place using the software and is only possible during the ACOPOS servo drive initialization phase:

   ParID 398: Setting for an internal / external braking resistor

   0 ... Internal (default)
   1 ... External
5) The fuses used must be fast-acting fuses ∅10 x 38 mm for 600 VAC/VDC.
   For example, type KLKD0xx (xx is the rated current of the fuse in amperes e.g. KLKD030) from Littelfuse (www.littelfuse.com) can be used.
6) The braking resistors integrated in ACOPOS servo drives 1010, 1016, 1022, 1045 and 1090 are optimally dimensioned for the respective sizes.

4.2 External Braking Resistor Connection

The external braking resistors are connected using terminals X6 / RB+, RB- and PE. The structure of the external braking resistor connection can be seen in the following diagram:

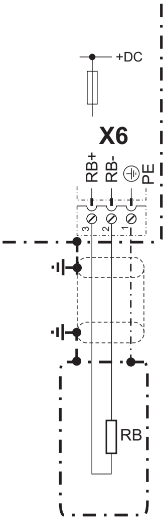


Figure 29: Circuit diagram for ACOPOS X6, external braking resistor on ACOPOS 1180/1320/1640/128M

When determining the cross section 1) for wiring the external braking resistor, make sure that the cross section selected is within the range that can be used with braking resistor connection terminal X6 (see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165).

---

1) The cross section of the braking resistor cable must be dimensioned for the thermal equivalent effective value of the respective brake current. If information concerning the flow of the brake current is available, calculate the thermal equivalent effective value of the brake current using

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The cross section of the braking resistor connection should then be selected as described in table 64 "Maximum current load for PVC insulated three-phase cables or individual wires" on page 126, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the brake current ($I_Z \geq I_q$).

4.3 Dimensioning the Braking Resistor

Like other drive components, the externally connected braking resistors must be dimensioned according to the requirements of the application.

To determine the required braking power (P_{Brmax} and P_{Braver}), the mechanical values M(t), ω(t) and T_{cycle} must be known. The following formulas are used to determine the drive power curve:

$$P(t)[W] = M(t)[Nm] \cdot \omega(t)[rad \cdot s^{-1}]$$

$$\omega(t)[rad \cdot s^{-1}] = 2 \cdot \pi \cdot \frac{n(t)[min^{-1}]}{60[s \cdot min^{-1}]}$$

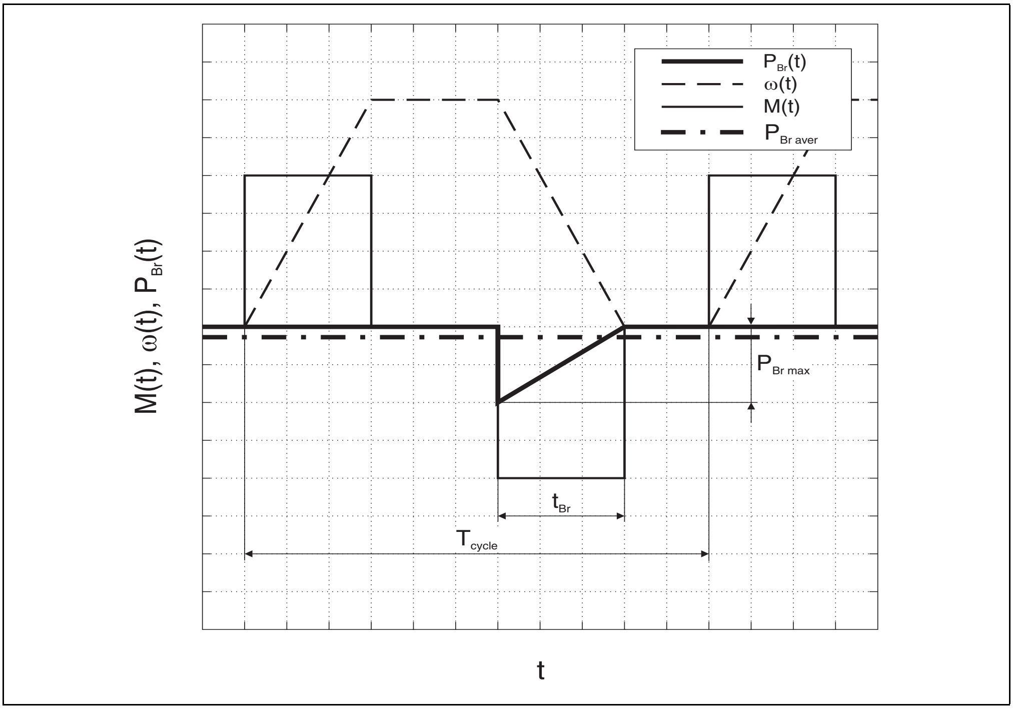


Figure 30: Diagram of a typical movement with the brake power curve $P_{Br}(t)$ 1)

1) If - as shown - a typical triangular brake power curve occurs, then the average brake power can be calculated directly with the following formula:

$$P_{BR_{mittel}}[W] = \frac{1}{T_{cycle}[s]} \cdot \frac{P_{Br_{max}} \cdot t_{Br}}{2}$$

The calculation is continued by deriving the brake power curve $P_{Br}(t)$ from the drive power curve. The power must be set to zero in areas where it is positive (P(t) > 0). This results in the following maximum brake power

$$P_{Br_{max}}[W] = abs(max(P_{Br}(t)[W]))$$

Then the average brake power is calculated over the given cycle

$$P_{Br_{aver}}[W] = \frac{1}{T_{cycle}[s]} \cdot \sum_{i} P_{Br_i}(t)[W] \cdot t_i[s]$$

In order to use an external braking resistor 1), the following parameters must be calculated:

- the resistance (R_{Br})
- the maximum power (P_{Brmax})
- the nominal power (P_{RBrN})

4.3.1 Resistance of the External Braking Resistor

The resistance of the external braking resistor R_{Br} can be calculated as follows:

$$R_{Br}[\Omega] = \frac{U_{DC}[V]^2}{P_{Br_{max}}[W]} = \frac{800[V]^2}{P_{Br_{max}}[W]}$$

The selected resistance is not allowed to be less than the **minimum** resistance for the respective ACOPOS servo drive (see table 67 "Braking resistors for ACOPOS servo drives" on page 136).

$$R_{Br}[\Omega] \geq R_{Br_{min}}[\Omega]$$

If this condition is not met, the maximum brake power required cannot be reached! Typical resistances are between 4 and 50 Ω depending on the size of the ACOPOS device.

> ## Caution!
>
> **If a resistance less than the minimum resistance is used, the brake chopper built into the ACOPOS servo drive could be destroyed!**

---

1) Reliable braking resistors are available from Danotherm (www.danotherm.com).

Then the following calculation

$$P_{Br_{aver}}[W] \leq R_{Br}[\Omega] \cdot I_B[A]^2$$

must be made to check if the average continuous power for the brake can be reached with the selected braking resistor on the ACOPOS servo drive. The brake power which can be continually output by the ACOPOS device is limited by the built-in fuse (rated current of the built-in fuse, see table 67 "Braking resistors for ACOPOS servo drives" on page 136).

4.3.2 Power Data for the External Braking Resistor

The maximum power that the external braking resistor must be able to dissipate is calculated as follows:

$$P_{R_{Br_{max}}}[W] \geq P_{Br_{max}}[W]$$

The nominal power (the power which can be continually dissipated) for the external braking resistor is calculated using the following formulas:

$$P_{R_{Br_N}}[W] \geq P_{Br_{aver}}$$

$$P_{R_{Br_N}}[W] \geq \frac{1}{30} \cdot P_{R_{Br_{max}}}[W]$$

The second condition depends on ACOPOS internal relationships.

4.3.3 Nominal Voltage of the External Braking Resistor

The external braking resistor must be selected so that it can handle the maximum voltage that can occur during operation.

During braking, voltages up to 900 VDC can occur.

Danger!

During braking, voltages up to 900 VDC can occur on the external braking resistor. The external braking resistor must be able to handle these voltages.

4.4 Setting Brake Resistor Parameters

The braking resistors integrated in the ACOPOS servo drives as well as braking resistors which can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

4.4.1 Using the Integrated Braking Resistors

No settings or configuration is required by the user.

4.4.2 Using External Braking Resistors

When using external braking resistors, the following parameters must be set on the ACOPOS servo drive using B&R Automation Studio™:

ParID	Formula Symbols	Description	Unit
10	R_{Br}	Ohmic resistance	[Ω]
11	$T_{Br_{max}}$	Maximum over-temperature on the external braking resistor	[°C]
12	$R_{Br_{Th}}$	Thermal resistance between braking resistor and the environment [1]	[°C/W]
13	$C_{Br_{Th}}$	Heat capacitance of the filament [2]	[Ws/°C]
398	---	Setting for an internal / external braking resistor 0 ... Internal (default) 1 ... External Switching is only possible during the ACOPOS servo drive initialization phase.	---

Table 68: ParIDs for setting external braking resistor parameters

1) Total thermal resistance for series or parallel connections of several (n_{Br}) of the **same** braking resistors:

$$R_{Br_{Th_{total}}} = \frac{R_{Br_{Th}}}{n_{Br}}$$

2) Total heat capacitance of the filament for series or parallel connections of several (n_{Br}) of the **same** braking resistors:

$$C_{Br_{Th_{total}}} = C_{Br_{Th}} \cdot n_{Br}$$

The parameters can normally be found on the data sheet from the manufacturer. [1]

---

1) An example of reliable braking resistors are Σ SIGMA type braking resistors from Danotherm (www.danotherm.com).

The parameters are based on the following thermal equivalent circuit for the external braking resistor:

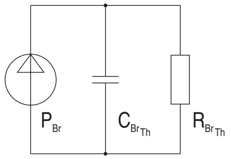


Figure 31: Thermal equivalent circuit for the external braking resistor

If a value for the maximum over-temperature of the external braking resistor is not given, it can be determined using the following formula:

$$T_{Br_{max}} = P_{R_{Br_N}} \cdot R_{Br_{Th}}$$

5. Configuration of ACOPOS Servo Drives

The plug-in modules for ACOPOS servo drives allow each servo drive to be individually configured according to the requirements of the application. When putting together plug-in module combinations, the power consumption must be checked. This then results in the current requirements of the ACOPOS servo drive configuration.

5.1 Maximum Power Output for All Slots on the ACOPOS Servo Drive

The maximum power output for all slots (P_{max}) depends on the size of the ACOPOS servo drive:

Description	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128M
P_{max}	Max. 16 W		Max. 22 W						

Table 69: Maximum power output for all slots depending on the ACOPOS servo drive

The total power consumption for all plug-in modules must be less than or equal to the ACOPOS servo drive's maximum power output:

$$\sum P_{module}[W] \leq P_{max}[W]$$

The power consumption of the individual plug-in modules can be found in table 70 "Power consumption P_{module} of ACOPOS plug-in modules" or the technical data for the modules (see chapter 2 "Technical Data"):

Plug-in module	Power consumption P_{module}
8AC110.60-2	Max. 0.7 W
8AC112.60-1	Max. 2.5 W
8AC120.60-1 E0 ... EnDat single-turn, 512 lines E1 ... EnDat multi-turn, 512 lines E2 ... EnDat single-turn, 32 lines (inductive) E3 ... EnDat multi-turn, 32 lines (inductive) E4 ... EnDat single-turn, 512 lines E5 ... EnDat multi-turn, 512 lines	Depends on the EnDat encoder connected Max. 2.3 W Max. 3.1 W Max. 3.1 W Max. 3.1 W Max. 2.4 W Max. 2.7 W
8AC122.60-2	Max. 1.2 W
8AC123.60-1	Max. 7.5 W Depends on the current requirements for the encoder connected [1)]
8AC130.60-1	Max. 0.8 W
8AC131.60-1	Max. 1 W
8AC140.60-1, 8AC140.61-2	Max. 4.5 W

Table 70: Power consumption P_{module} of ACOPOS plug-in modules

1) The power consumption of the plug-in module can be approximated using the following formula:

P_{Module} [W] = $P_{Encoder}$ [W] · k + 0.6 W

The power consumed by the encoder $P_{Encoder}$ is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:

$P_{Encoder}$ [W] = $U_{Encoder}$ [V] · $I_{Encoder}$ [A]

The following values must be used for k:

k = 1.2 (for 15 V encoder supply)
k = 1.75 (for 5 V encoder supply)

5.2 24 VDC Current Requirements for the ACOPOS Servo Drive

The 24 VDC current requirements (I_{24VDC}) must be regarded differently depending on the size of the ACOPOS servo drive.

- The following estimation can always be used for the ACOPOS 1010, 1016, 1022, 1045 and 1090:

$$I_{24VDC}[A] = I_{24VDC_{max}}[A] - \frac{1,1}{24V \cdot k} \cdot (P_{max} - \sum P_{module}[W])$$

- This estimation can also be used for the ACOPOS 1180, 1320, 1640 and 128M as long as a mains input voltage is not applied. As soon as a mains input voltage is applied to these servo drives, the 24 VDC supply voltage is created via the integrated DC bus power supply; the 24 VDC current requirements (I_{24VDC}) is then reduced to 0.

The 24 VDC maximum current requirements for the ACOPOS servo drives can be found in table 71 "Maximum current requirements and constant k" or the technical data for the ACOPOS servo drives (see chapter 2 "Technical Data").

Description	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128M
$I_{24VDC_{max}}$	In preparation		2.5			2.8		4.6	5.7
k	In preparation		0.64			0.63		0.58	

Table 71: Maximum current requirements and constant k

The 24 VDC total current consumption for the ACOPOS servo drive is made up of the 24 VDC current requirements, the current on the 24 VDC output (only for ACOPOS 1180/1320/1640/128M) and the current for the motor holding brake (if used):

$$I_{24VDC_{total}} = I_{24VDC} + I_{24VDC_{out}} + I_{Br}$$

In this case, make sure that the 24 VDC total current consumption does not exceed the maximum current load for the connection terminals.

6. Formula Variables Used

Character	Unit	Description
C_A	F	Discharge capacitance
$C_{Br_{Th}}$	Ws/°C	Heat capacitance of the filament
k	---	General constants
f_{mains}	Hz	Mains frequency
I_{24VDC}	A	24 VDC current requirements
$I_{24VDC_{max}}$	A	24 VDC maximum current requirements
$I_{24VDC_{total}}$	A	24 VDC Total Current Consumption
$I_{24VDC_{out}}$	A	Current on 24 VDC Output of the ACOPOS Servo Drive (max. 0.5 A)
I_A	A	Discharge current via protective ground conductor (PE)
I_B	A	Rated current for overcurrent protection
I_{mains}	A	Mains current (phase current)
I_q	A	Thermal equivalent current effective value
I_Z	A	Maximum current load on a cable
M	Nm	Torque (general)
M_{eff}	Nm	Effective load torque for a cycle
n	min^{-1}	Speed (general)
n_{aver}	min^{-1}	Average speed for a cycle
ω	rad/s	Rotational Speed
P	W	Power or true power (general)
P_{Br}	W	Brake power
$P_{Br_{max}}$	W	Maximum brake power
$P_{Br_{aver}}$	W	Average brake power
$P_{R_{Br_{max}}}$	W	Maximum load on the external braking resistor
$P_{R_{Br_N}}$	W	Nominal power of the external braking resistor
P_{max}	W	Maximum power output for all slots
P_{module}	W	Power consumption of the ACOPOS plug-in modules
p	---	Pi (3.1415)
R_{Br}	Ω	Braking resistor
$R_{Br_{min}}$	Ω	Minimum braking resistance
$R_{Br_{Th}}$	°C/W	Thermal resistance between braking resistor and the environment
S	VA	Apparent power
t	s	Time (general)
t_{Br}	s	Braking time
$T_{Br_{max}}$	°C	Maximum over-temperature of the resistor
T_{cycle}	s	Cycle time
U_{DC}	V	DC bus voltage
U_{mains}	V	Supply voltage (phase to phase)

Table 72: Formula variables used

Chapter 5 • Wiring

1. General Information

1.1 Electromagnetic Compatibility of the Installation

1.1.1 General Information

If the guidelines for elecromagnetic compatibility of the installation are followed, ACOPOS servo drives meet EMC guidelines 89/336/EWG and low-voltage guidelines 73/23/EWG. They meet the requirements for harmonized EMC product standard IEC 61800-3:1996 + A11:2000 for industry (second environment).

Additional EMC measures must be implemented by the manufacturer of machines or systems if the product standards for the machine has lower limits or if the machine should conform to generic standard IEC 61000-6-4. Additional EMC measures may also be needed for machines with a large number of ACOPOS servo drives. The installation of a central line filter is mostly sufficient in such cases. Proof of conformity to the necessary limits must be provided according to the documentation for use of the EMC guidelines from the manufacturer or distributor of the machine or system.

Additional EMC measures are needed when operating ACOPOS servo drives in living area or when connecting ACOPOS servo drives to a low voltage system which supplies buildings in living areas without an intermediate transformer (first environment).

1.1.2 Installation Notes

1) The switching cabinet or the system must be constructed appropriately.

2) To prevent the effects of disturbances, the following lines must be properly shielded:

   - motor lines
   - encoder cables
   - control lines
   - data cables

3) Inductive switching elements such as contactors or relays are to be equipped with corresponding suppressor elements such as varistors, RC elements or damping diodes.

4) All electrical connections are to be kept as short as possible.

5) Cable shields are to be attached to the designated shield terminals and the plug housing.

6) Shielded cables with copper mesh or tinned copper mesh are to be used. Twisting or extending the protective mesh using single conductors is not allowed.

7) Unused cable conductors are to be grounded on both sides if possible.

The ground connections and shield connections have to be made as illustrated in the following diagram.

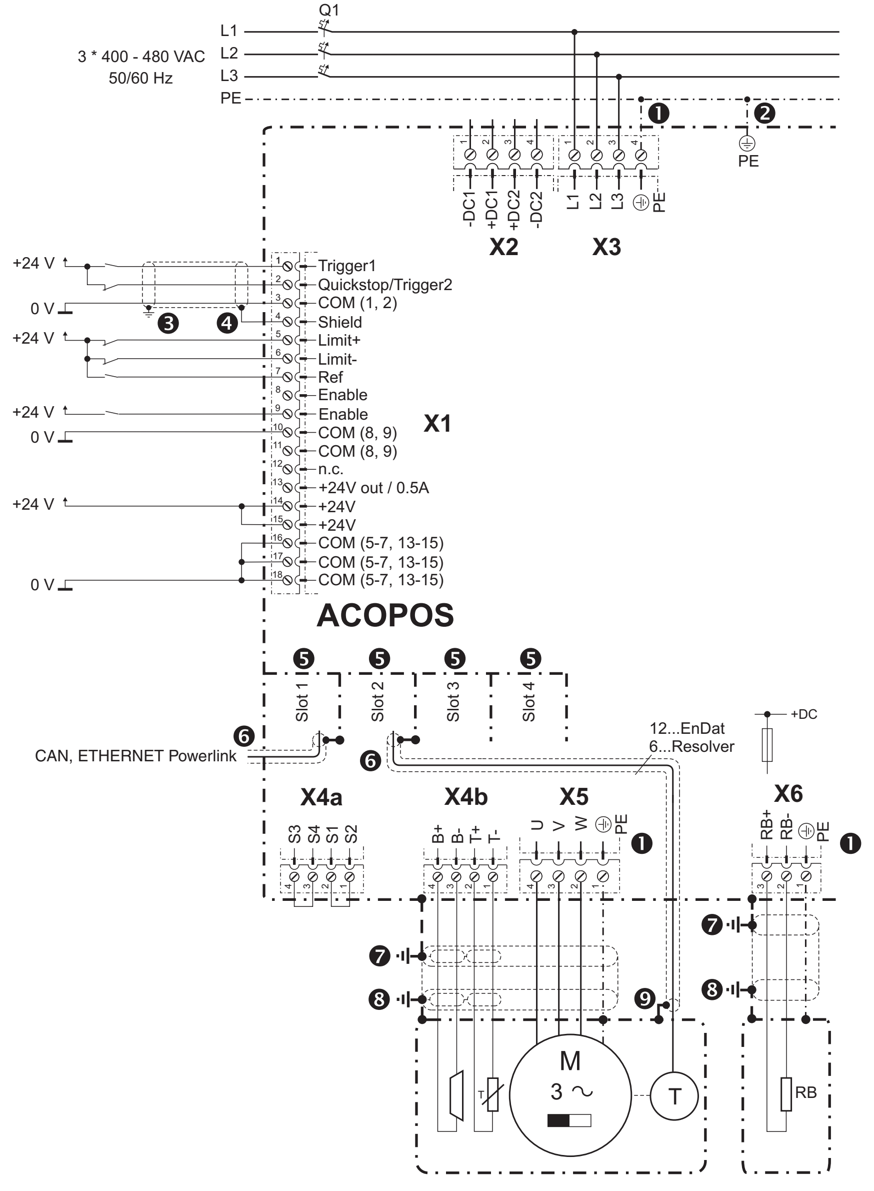

Q1
3 * 400 - 480 VAC
50/60 Hz
L1
L2
L3
PE
❶
❷
PE
-DC1
+DC1
+DC2
-DC2
L1
L2
L3
PE
X2
X3
+24 V
0 V
❸
❹
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
Enable
COM (8, 9)
COM (8, 9)
n.c.
+24V out / 0.5A
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
X1
ACOPOS
❺
Slot 1
Slot 2
Slot 3
Slot 4
❻
CAN, ETHERNET Powerlink
12...EnDat
6...Resolver
+DC
X4a
X4b
X5
X6
S3
S4
S1
S2
B+
B-
T+
T-
U
V
W
PE
RB+
RB-
PE
❼
❽
❾
M
3 ~
T
RB

Figure 32: Connection diagram for ground and shield connections

➊ The protective ground conductors (PE) for the power mains, the motor lines and external braking resistor connection are internally connected with the housing of the ACOPOS servo drive.

➋ The second protective ground conductor connection is required because of the increased discharge current (> 3.5 mA) on ACOPOS servo drives 1022, 1045, 1090, 1180 and 1320. The same cross section as the power mains protective ground conductor must be used.

➌ Both trigger inputs are only filtered internally with approx. 50 µs. Make sure the cable shield is grounded properly.

➍ The cable shield must be attached to the shield connector.

➎ On all plug-in modules, the two screws used to fasten the module must be tightened so that the mounting bracket is connected to ground.

➏ Cable connection via DSUB plug:
The cable shield must be connected using the designated clamp in the metallic or metal plated plug housing. The fastening screws must be tightened.

Cable connection via terminals:
The cable shield must be attached to the shield connection terminal.

Cable connection via RJ45 plug:
Also grounding the cable shield provides an improvement in EMC properties. Grounding should take place on both sides, extensively and near to the connector.

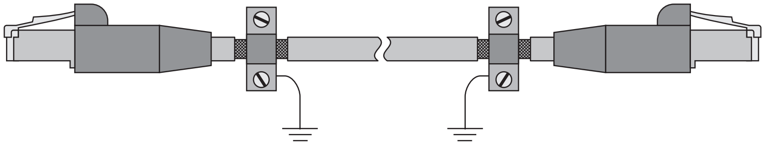


Figure 33: Cable shield grounding for the ETHERNET Powerlink cable

❼ The cable shield for the motor line or the connection cable for the external braking resistor is connected with the housing of the ACOPOS servo drive via the grounding plate using the grounding clamp provided:

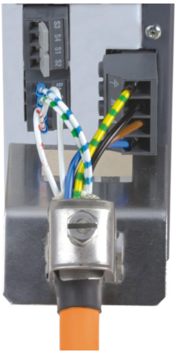
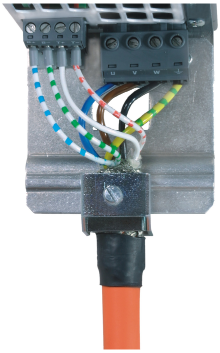
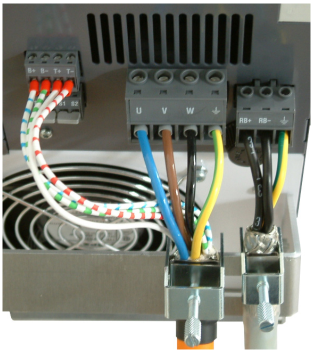
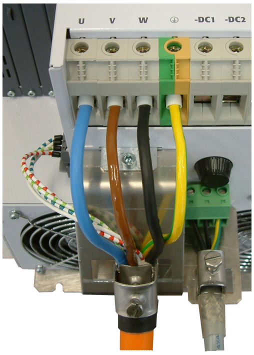
Shield connection for the motor cable using grounding clamps	
ACOPOS 1010, 1016	ACOPOS 1022, 1045, 1090
	
ACOPOS 1180, 1320	ACOPOS 1640, 128M
	

Table 73: Grounding of the motor cable on the ACOPOS servo drive

❽ On the motor side, the cable shield for the motor line is connected to the motor housing using the motor plug and connected to ground via the machine.
The cable shield on the connection cable for the external braking resistor must be connected with the housing of the braking resistor.

❾ On the motor side, the encoder cable shield is connected to the motor housing using the encoder plug and connected to ground via the machine.

1.2 Connecting Cables to Plug-in Modules

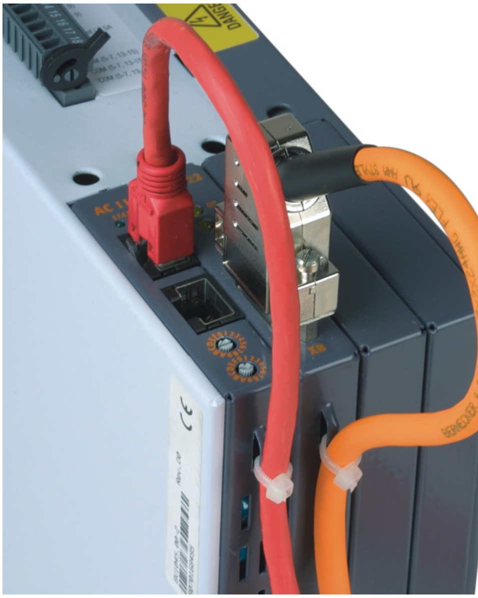


Figure 34: Connecting Cables to Plug-in Modules

Stress relief for the cable is implemented using a cable tie. The cable tie is to be run through the eye on the bottom of the plug-in module.

Make sure that the ventilation slots on the bottom of the ACOPOS drive are not blocked.

1.3 Secure Restart Inhibit

1.3.1 General Information

ACOPOS servo drives have a built-in secure restart inhibit to guarantee that the device is stopped securely and to prevent it from restarting unexpectedly. It is designed to correspond with safety category 3 according to EN 954-1. 1)

In addition to preventing the device from restarting unexpectedly according to EN 1037, this safety function also meets the requirements of EN 60204-1 regarding the stop function for categories 0 and 1. Both stop functions require the supply to the machine drives to be switched off (immediately for category 0 and after stopping for category 1).

The secure restart inhibit interrupts the supply to the motor by preventing the pulses to the IGBTs. In this way, a rotating field can no longer be creating in synchronous and asynchronous motors controlled by the ACOPOS servo drives. This fulfills the requirements of EN 1037 regarding preventing the device from starting unexpectedly and IEC 60204-1 regarding the stop function for categories 0 and 1. 2)

Danger!

Take note that multiple errors in the IGBT bridge can cause a short forward movement. The maximum rotary angle of the forward movement φ on the motor shaft depends on the motor used. For permanently excited synchronous motors, $\varphi = 360°/2p$ (for B&R standard motors, $p = 3$ and the angle is therefore 60°). For three-phase current asynchronous motors, there is a relatively small angle of rotation (between 5° and 15°).

For applications where this can be dangerous, the desired level of protection cannot be obtained.

---

1) TÜV: Sample test for secure restart inhibit according to EN 954-1 category 3 is in preparation.

2) A detailed explanation of the standards and categories can be found in chapter 7 "Standards and Certifications".

1.3.2 Principle - Realization of the Safety Function

Secure restart inhibit is obtained by removing the IGBT driver supply. Terminals X1 / Enable and X1 / COM(8, 9) are used to supply an integrated DC-DC converter with 24 VDC. The converter creates the supply voltage for the IGBT driver from this voltage.

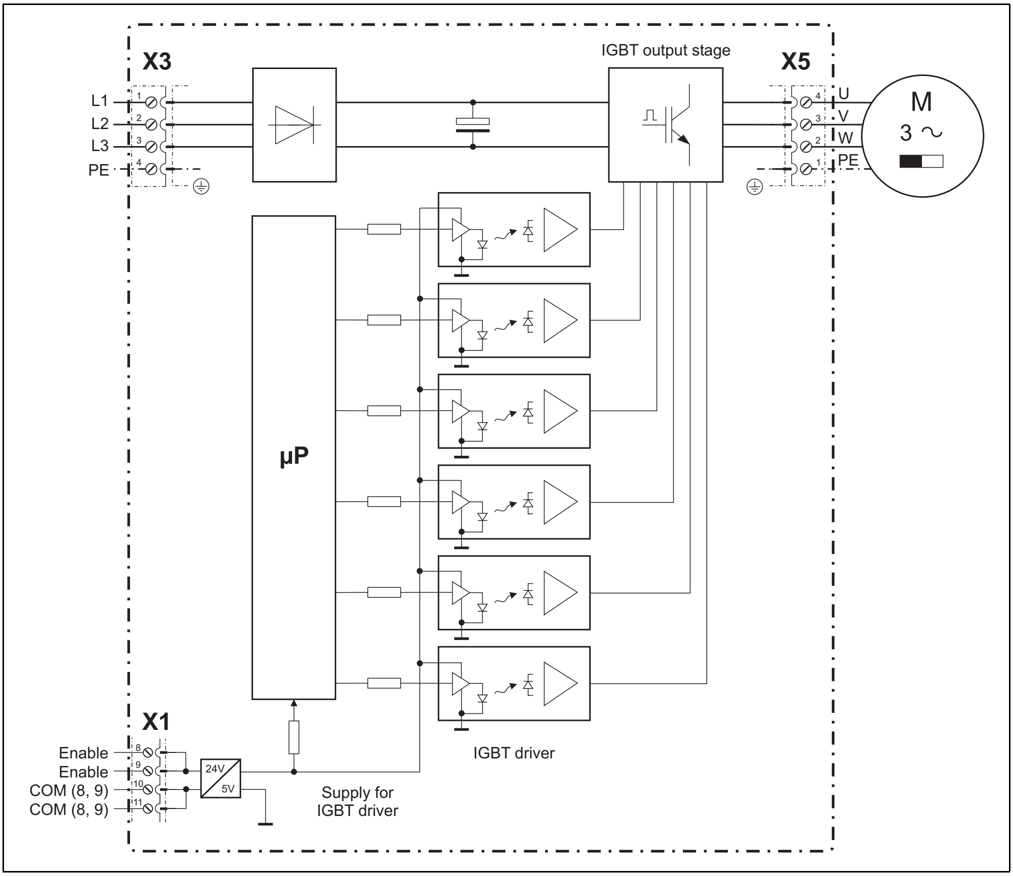

X3
L1
L2
L3
PE
1
2
3
4
IGBT output stage
X5
U
V
W
PE
4
3
2
1
M
3 ~
µP
X1
Enable
Enable
COM (8, 9)
COM (8, 9)
8
9
10
11
24V
5V
Supply for
IGBT driver
IGBT driver

Figure 35: Block diagram of secure restart inhibit

If the 24 VDC voltage supply for the DC-DC converter is interrupted, the IGBT driver is also no longer supplied. It is then no longer possible to transfer the modulation pattern needed to generate the rotating field on the IGBT output stage.

Additional Function

The availability of the DC-DC converter output voltage can be requested from the microprocessor. If voltage is not present, the generation of the modulation pattern is suppressed by the microprocessor.

Danger!

After activating the secure restart inhibit using terminals X1 / Enable and X1 / COM(8, 9), the motor is de-energized and therefore torque-free. If the motor was moving before activation of the secure restart inhibit, it is only stopped by an operational brake (available under certain conditions) or from the friction of the entire system. Therefore, the motor is not able to hold hanging loads. Holding brakes must be used for this purpose.

For applications where this can be dangerous, the desired level of protection cannot be obtained.

1.3.3 External Wiring

The following section contains four wiring suggestions for the external wiring of the secure restart inhibit. In accordance to EN 60204-1, they vary based on the category of the stop function (category 0, 1 and 2).

All wiring suggestions offer three functions:

- Stop function
- Restart inhibit
- Low speed

In addition, all wiring suggestions offer an E-stop function; this must be designed in accordance to EN 60204-1 as category 0 or 1 stop function.

All functions, designed as category 0 or 1 stop function in accordance to EN 60204-1, meet the safety category 3 according to EN 954-1.

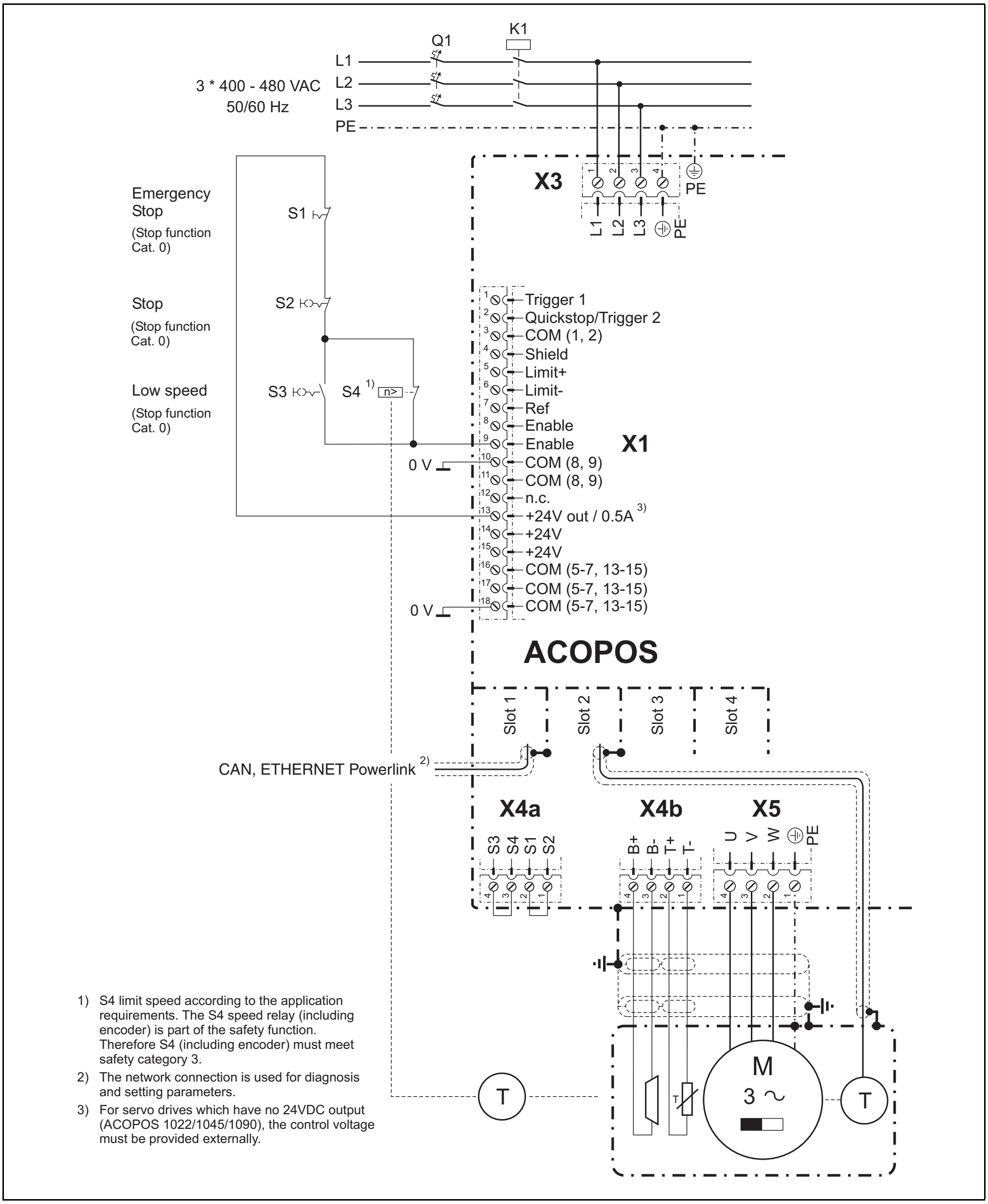
Danger!

One or two pin switching devices from safety category 2 (reliable switching devices) must be used for the switches S1, S2 and S3 described in the wiring suggestions.

To achieve safety category 3 according to EN 954-1, functionality must be checked once a day.

For applications where this is not possible, the desired level of protection cannot be obtained.

Stop Function for Category 0 – Safety Category 3


K1
Q1
L1
3 * 400 - 480 VAC
50/60 Hz
L2
L3
PE
X3
PE
L1
L2
L3
PE
Emergency Stop
(Stop function Cat. 0)
S1
Stop
(Stop function Cat. 0)
S2
Low speed
(Stop function Cat. 0)
S3
S4 1)
n>
Trigger 1
Quickstop/Trigger 2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
Enable
X1
0 V
COM (8, 9)
COM (8, 9)
n.c.
+24V out / 0.5A 3)
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
0 V
COM (5-7, 13-15)
ACOPOS
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink 2)
X4a
X4b
X5
S3
S4
S1
S2
B+
B-
T+
T-
U
V
W
PE
T
M
3 ~
T

1) S4 limit speed according to the application requirements. The S4 speed relay (including encoder) is part of the safety function. Therefore S4 (including encoder) must meet safety category 3.

2) The network connection is used for diagnosis and setting parameters.

3) For servo drives which have no 24VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Figure 36: External wiring for the stop function in category 0 – safety category 3

Description

Secure stop function:

By pressing the E-stop switch S1 (cat. 0 stop function) or stop switch S2 (cat. 0 stop function), the drive has no torque and spins out.

This guarantees that the energy feed to the motor is immediately switched off.

Secure restart inhibit:

Restart is inhibited by opening and locking stop switch S2.

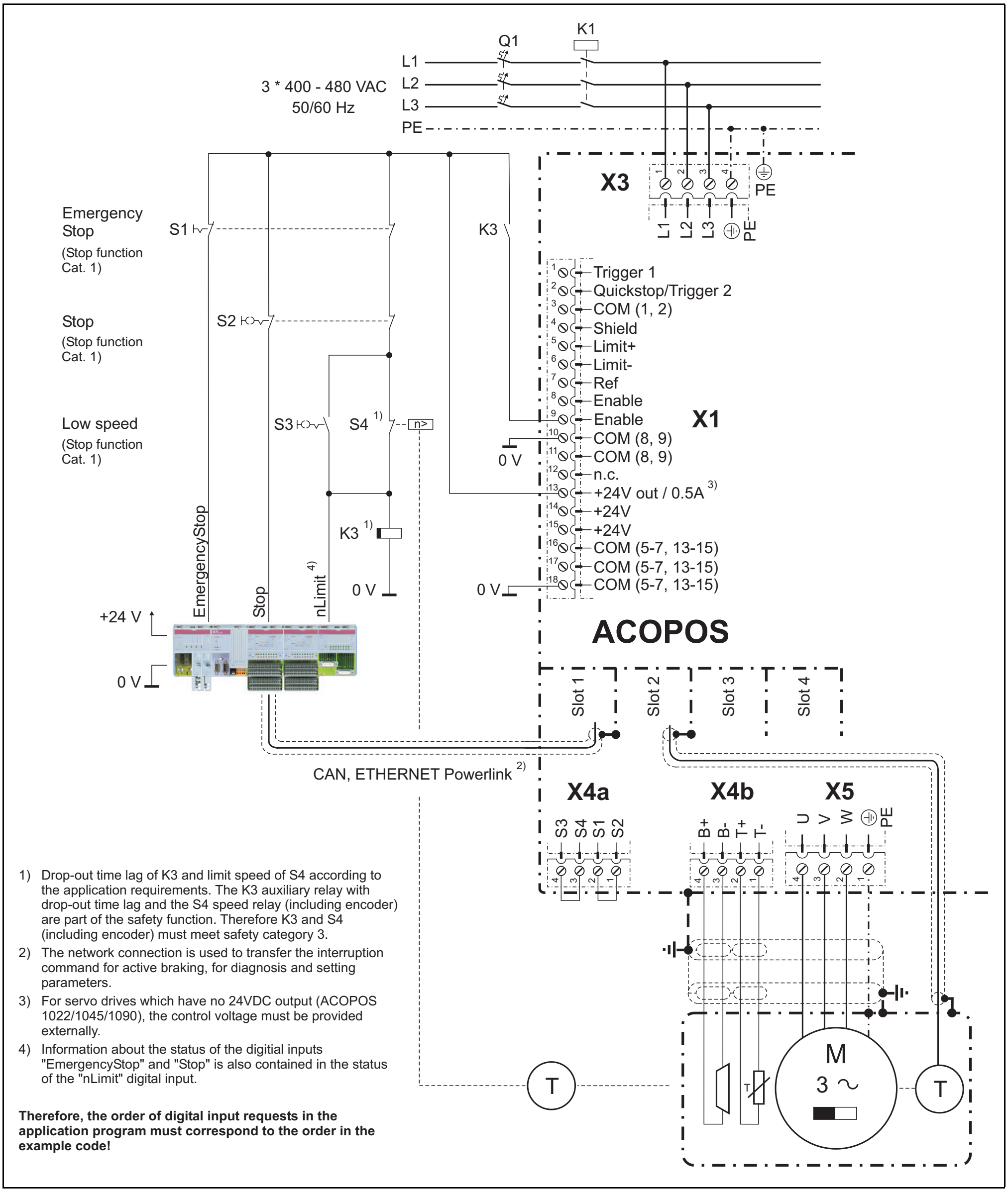
Secure low speed:

The secure low speed is activated by opening switch S3. If the limit speed set on the speed relay S4 is exceeded, the speed relay S4 (cat. 0 stop function) opens and the drive loses torque and spins out.

This guarantees that the energy feed to the motor is immediately switched off.

Stop Function for Category 1 – Safety Category 3

Type 1 – Starting active braking over the network


Q1
K1
3 * 400 - 480 VAC
50/60 Hz
L1
L2
L3
PE
X3
1
2
3
4
PE
L1
L2
L3
PE
Emergency Stop
(Stop function Cat. 1)
S1
K3
Stop
(Stop function Cat. 1)
S2
Low speed
(Stop function Cat. 1)
S3
S4 1)
n>
K3 1)
0 V
0 V
0 V
EmergencyStop
Stop
nLimit 4)
+24 V
0 V
1 Trigger 1
2 Quickstop/Trigger 2
3 COM (1, 2)
4 Shield
5 Limit+
6 Limit-
7 Ref
8 Enable
9 Enable
10 COM (8, 9)
11 COM (8, 9)
12 n.c.
13 +24V out / 0.5A 3)
14 +24V
15 +24V
16 COM (5-7, 13-15)
17 COM (5-7, 13-15)
18 COM (5-7, 13-15)
X1
ACOPOS
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink 2)
X4a
S3
S4
S1
S2
4
3
2
1
X4b
B+
B-
T+
T-
4
3
2
1
X5
U
V
W
PE
4
3
2
1
T
M
3 ~
T
T

1) Drop-out time lag of K3 and limit speed of S4 according to the application requirements. The K3 auxiliary relay with drop-out time lag and the S4 speed relay (including encoder) are part of the safety function. Therefore K3 and S4 (including encoder) must meet safety category 3.
2) The network connection is used to transfer the interruption command for active braking, for diagnosis and setting parameters.
3) For servo drives which have no 24VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.
4) Information about the status of the digitial inputs "EmergencyStop" and "Stop" is also contained in the status of the "nLimit" digital input.

Therefore, the order of digital input requests in the application program must correspond to the order in the example code!

Figure 37: Type 1 – Starting active braking over the network

Description

Secure stop function:

When the E-stop switch S1 (cat. 1 stop function) is pressed, the "EmergencyStop" digital input on the controller triggers active braking (see following code example).

If the controller, the network, the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

Pressing stop switch S2 (cat. 1 stop function) basically triggers the same procedure, but is handled differently by the software (separate digital input "Stop" on the controller).

This guarantees that the energy feed to the motor is definitely switched off afterwards.

Secure restart inhibit:

Restart is inhibited by opening and locking stop switch S2.

Secure low speed:

The secure low speed is activated by opening switch S3. If the limit speed set on the speed relay S4 is exceeded, the speed relay S4 (cat. 1 stop function) opens and the "nLimit" digital input on the controller triggers active braking (see following code example).

If the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

This guarantees that the energy feed to the motor is definitely switched off afterwards.

Code Example

Trigger the stop command (via CAN bus or ETHERNET Powerlink).

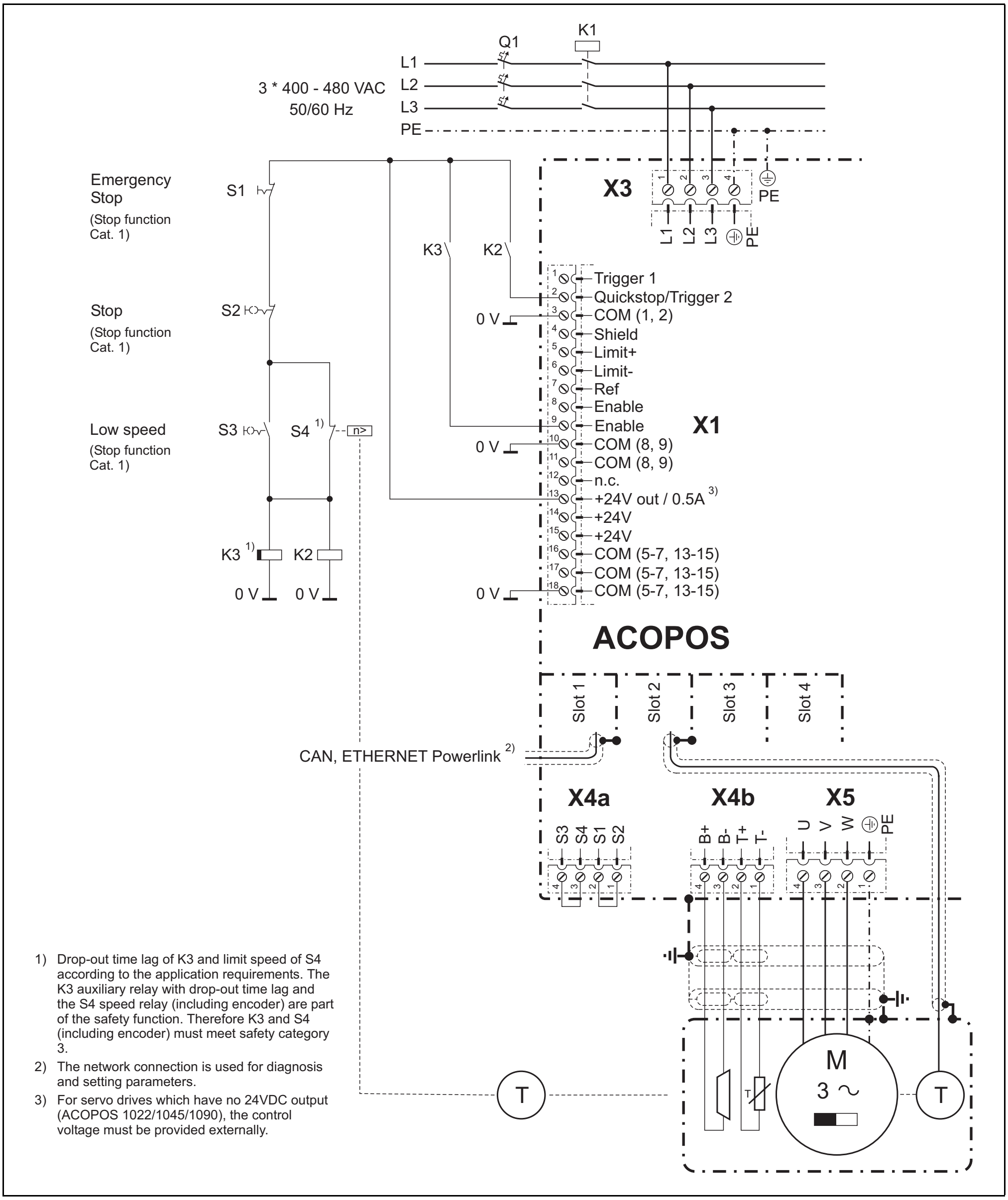
```
if ( ! stop_active )
{
/* Movement stop not active: Test stop inputs */
    if ( EmergencyStop == ncLOW )
    {
    /* Activate movement stop with parameter set for "emergency stop" */
       stop_index = E_STOP_INDEX;
       step = MOV_STOP;
       stop_active = 1;
    }
    else if ( Stop == ncLOW )
    {
    /* Activate movement stop with parameter set for "stop" */
       stop_index = STOP_INDEX;
       step = MOV_STOP;
       stop_active = 1;
    }
    else if ( nLimit == ncLOW )
    {
    /* Activate movement stop with parameter set for "low speed" */
       stop_index = NLIMIT_INDEX;
       step = MOV_STOP;
       stop_active = 1;
    }
}
else
{
/* Movement stop was activated */
    if ( EmergencyStop == ncHIGH && Stop == ncHIGH && nLimit == ncHIGH
          && step!= W_MOVE_STOP )
    {
    /* Movement stop completed */
       stop_active = 0;
    }
}

switch(step)
{
    ...
    case MOV_STOP:
    /* Call NC action for movement stop */
        p_ax_dat->move.stop.index.command = stop_index;

        action_status = ncaction(ax_obj,ncMOVE,ncSTOP);
        if ( action_status == ncOK )
        {
            step = W_MOVE_STOP;
        }
        break;

    case W_MOVE_STOP:
    /* Wait for completion of movement stop */
        if (p_ax_dat->move.mode == ncOFF)
        {
        /* Movement stop completed */
            step = <NEXT_STEP>
        }
        break;
    ...
}
```

Type 2 – Starting active braking using the Quickstop input on the ACOPOS


K1
Q1
L1
L2
L3
PE
3 * 400 - 480 VAC
50/60 Hz
Emergency Stop
(Stop function Cat. 1)
S1
X3
PE
L1 L2 L3 PE
K3
K2
Trigger 1
Quickstop/Trigger 2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
Enable
COM (8, 9)
COM (8, 9)
n.c.
+24V out / 0.5A 3)
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
X1
0 V
Stop
(Stop function Cat. 1)
S2
Low speed
(Stop function Cat. 1)
S3
S4 1)
n>
K3 1)
K2
0 V
ACOPOS
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink 2)
X4a
S3 S4 S1 S2
X4b
B+ B- T+ T-
X5
U V W PE
M
3 ~
T

1) Drop-out time lag of K3 and limit speed of S4 according to the application requirements. The K3 auxiliary relay with drop-out time lag and the S4 speed relay (including encoder) are part of the safety function. Therefore K3 and S4 (including encoder) must meet safety category 3.

2) The network connection is used for diagnosis and setting parameters.

3) For servo drives which have no 24VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Figure 38: Type 2 – Starting active braking using the Quickstop input on the ACOPOS

Description

Secure stop function:

Pressing E-stop switch S1 (cat. 1 stop function) causes relay K2 to be released. In this way, the ACOPOS input "Quickstop" triggers active braking.

If the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

Pressing stop switch S2 (cat. 1 stop function) starts the same procedure as for type 1.

This guarantees that the energy feed to the motor is definitely switched off afterwards.

Secure restart inhibit:

Restart is inhibited by opening and locking stop switch S2.

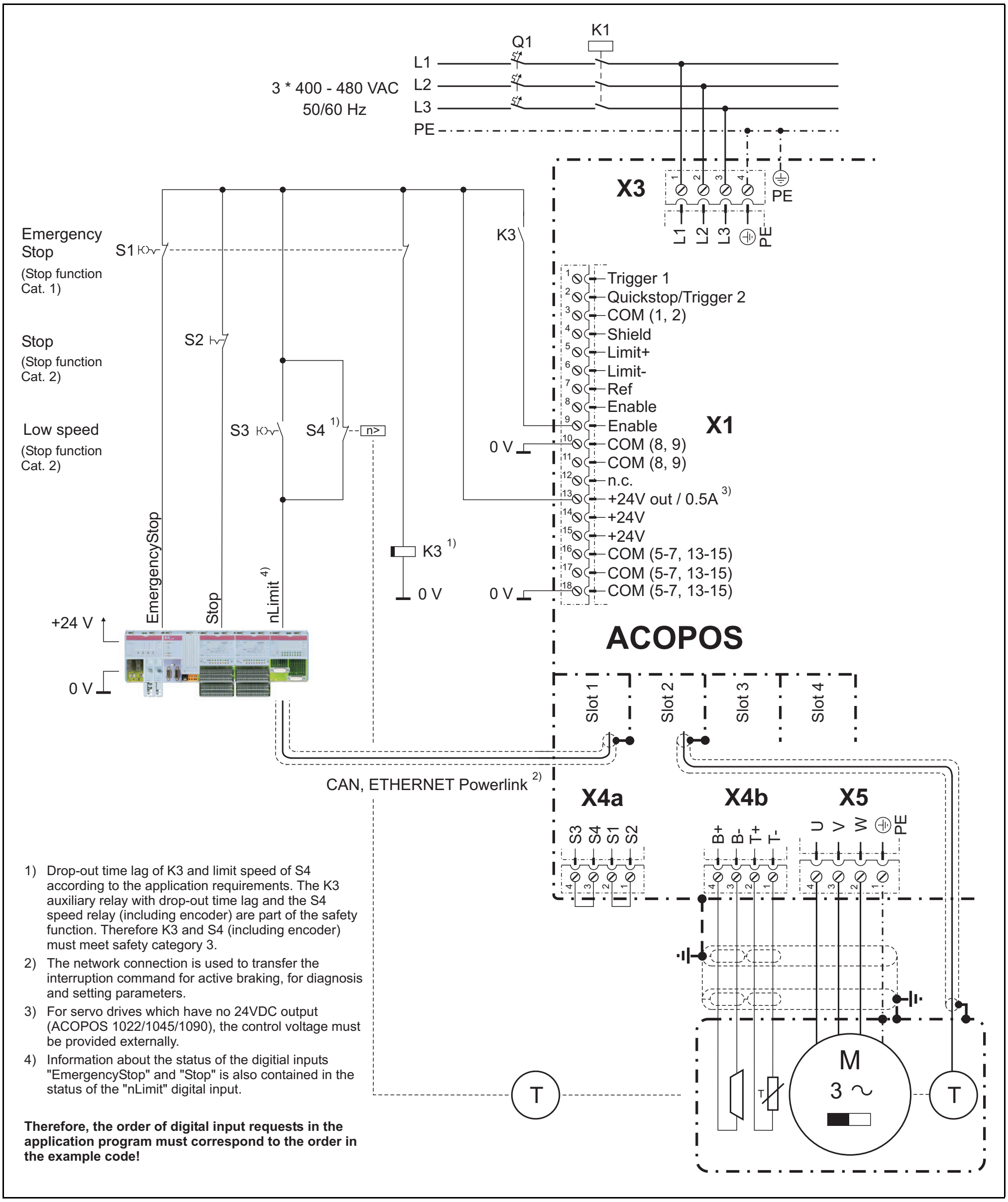
Secure low speed:

The secure low speed is activated by opening switch S3. If the limit speed set on the speed relay S4 is exceeded, the speed relay S4 (cat. 1 stop function) opens and relay K2 is released. In this way, the ACOPOS input "Quickstop" triggers active braking.

If the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

This guarantees that the energy feed to the motor is definitely switched off afterwards.

Stop Function for Category 2 – Safety Category 3


K1
Q1
L1
L2
L3
PE
3 * 400 - 480 VAC
50/60 Hz
X3
1
2
3
4
PE
L1
L2
L3
PE
Emergency Stop
(Stop function Cat. 1)
S1
K3
Stop
(Stop function Cat. 2)
S2
Low speed
(Stop function Cat. 2)
S3
S4 1)
n>
0 V
K3 1)
0 V
0 V
EmergencyStop
Stop
nLimit 4)
+24 V
0 V
1 Trigger 1
2 Quickstop/Trigger 2
3 COM (1, 2)
4 Shield
5 Limit+
6 Limit-
7 Ref
8 Enable
9 Enable
10 COM (8, 9)
11 COM (8, 9)
12 n.c.
13 +24V out / 0.5A 3)
14 +24V
15 +24V
16 COM (5-7, 13-15)
17 COM (5-7, 13-15)
18 COM (5-7, 13-15)
X1
ACOPOS
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink 2)
X4a
S3
S4
S1
S2
X4b
B+
B-
T+
T-
X5
U
V
W
PE
4
3
2
1
M
3 ~
T
T

1) Drop-out time lag of K3 and limit speed of S4 according to the application requirements. The K3 auxiliary relay with drop-out time lag and the S4 speed relay (including encoder) are part of the safety function. Therefore K3 and S4 (including encoder) must meet safety category 3.

2) The network connection is used to transfer the interruption command for active braking, for diagnosis and setting parameters.

3) For servo drives which have no 24VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

4) Information about the status of the digitial inputs "EmergencyStop" and "Stop" is also contained in the status of the "nLimit" digital input.

Therefore, the order of digital input requests in the application program must correspond to the order in the example code!

Figure 39: External wiring for the stop function in category 2 – safety category 3

Description

Stop function:

When the E-stop switch S1 (cat. 1 stop function) is pressed, the "EmergencyStop" digital input on the controller triggers active braking (see "Code Example", on page 159).

If the controller, the network, the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

This guarantees that the energy feed to the motor is definitely switched off afterwards.

Pressing stop switch S2 (cat. 2 stop function) basically triggers the same procedure, but is handled differently by the software (separate digital input "Stop" on the controller). However, the energy feed to the motor is not switched off after stopping.

Secure restart inhibit:

If you open and lock E-stop switch S1, restart is inhibited.

Low speed:

The low speed is activated by pressing the switch S3. If the limit speed set on the speed relay S4 is exceeded, the speed relay S4 (cat. 2 stop function) opens and the "nLimit" digital input on the controller triggers active braking.

The energy feed to the motor is not switched off after stopping.

1.4 Overview of the Terminal Cross Sections [1)]

Connector	Wire Types Approbation Data	8V1010.00-2 8V1010.50-2 8V1016.00-2 8V1016.50-2		8V1022.00-2 8V1045.00-2 8V1090.00-2		8V1180.00-2 8V1320.00-2		8V1640.00-2		8V128M.00-2	
		[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]
X1	Solid core / multiple conductor lines	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Flexible and fine wire lines										
	without Wire Tip Sleeves	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	with Wire Tip Sleeves	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Approbation Data										
	UL/C-UL-US	---	26 - 14	---	26 - 14	---	26 - 14	---	26 - 14	---	26 - 14
	CSA	---	26 - 14	---	26 - 14	---	26 - 14	---	26 - 14	---	26 - 14
Holding Torque for the Terminal Screws [Nm]		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25	
X2 DC Bus	Solid core / multiple conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines										
	without Wire Tip Sleeves	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	with Wire Tip Sleeves	0.25 - 4	23 - 10	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data										
	UL/C-UL-US	---	30 - 10	---	30 - 10	---	20 - 8	---	10 - 2	---	6 - 2/0
	CSA	---	28 - 10	---	28 - 10	---	20 - 8	---	12 - 2	---	6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X3 Power mains	Solid core / multiple conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines										
	without Wire Tip Sleeves	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	with Wire Tip Sleeves	0.25 - 4	23 - 10	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data										
	UL/C-UL-US	---	30 - 10	---	30 - 10	---	20 - 8	---	10 - 2	---	6 - 2/0
	CSA	---	28 - 10	---	28 - 10	---	20 - 8	---	12 - 2	---	6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X4a, X4b Motor (holding brake, temperature sensor)	Solid core / multiple conductor lines	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12
	Flexible and fine wire lines										
	without Wire Tip Sleeves	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12
	with Wire Tip Sleeves	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12
	Approbation Data										
	UL/C-UL-US	---	30 - 12	---	30 - 12	---	30 - 12	---	30 - 12	---	30 - 12
	CSA	---	28 - 12	---	28 - 12	---	28 - 12	---	28 - 12	---	28 - 12
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6	
X5 Motor (power)	Solid core / multiple conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines										
	without Wire Tip Sleeves	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	with Wire Tip Sleeves	0.25 - 4	23 - 10	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data										
	UL/C-UL-US	---	30 - 10	---	30 - 10	---	20 - 8	---	10 - 2	---	6 - 2/0
	CSA	---	28 - 10	---	28 - 10	---	20 - 8	---	12 - 2	---	6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X6 External braking resistor	Solid core / multiple conductor lines	---	---	---	---	0.2 - 4	24 - 10	0.5 - 10	20 - 7	0.5 - 10	20 - 7
	Flexible and fine wire lines										
	without Wire Tip Sleeves	---	---	---	---	0.2 - 4	24 - 10	0.5 - 6	20 - 9	0.5 - 6	20 - 9
	with Wire Tip Sleeves	---	---	---	---	0.25 - 4	23 - 10	0.5 - 6	20 - 9	0.5 - 6	20 - 9
	Approbation Data										
	UL/C-UL-US	---	---	---	---	---	30 - 10	---	20 - 8	---	20 - 8
	CSA	---	---	---	---	---	28 - 10	---	20 - 8	---	20 - 8
Holding Torque for the Terminal Screws [Nm]		---		---		0.5 ... 0.6		1.2 ... 1.5		1.2 ... 1.5	

Table 74: Terminal cross sections for ACOPOS servo drives

1) ACOPOS 1022/1045/1090 revision I0 and up; ACOPOS 1180/1320 revision F0 and up; ACOPOS 1640 revision K0 and up; ACOPOS 128M revision C0 and up.

2. Pin Assignments ACOPOS 1010, 1016

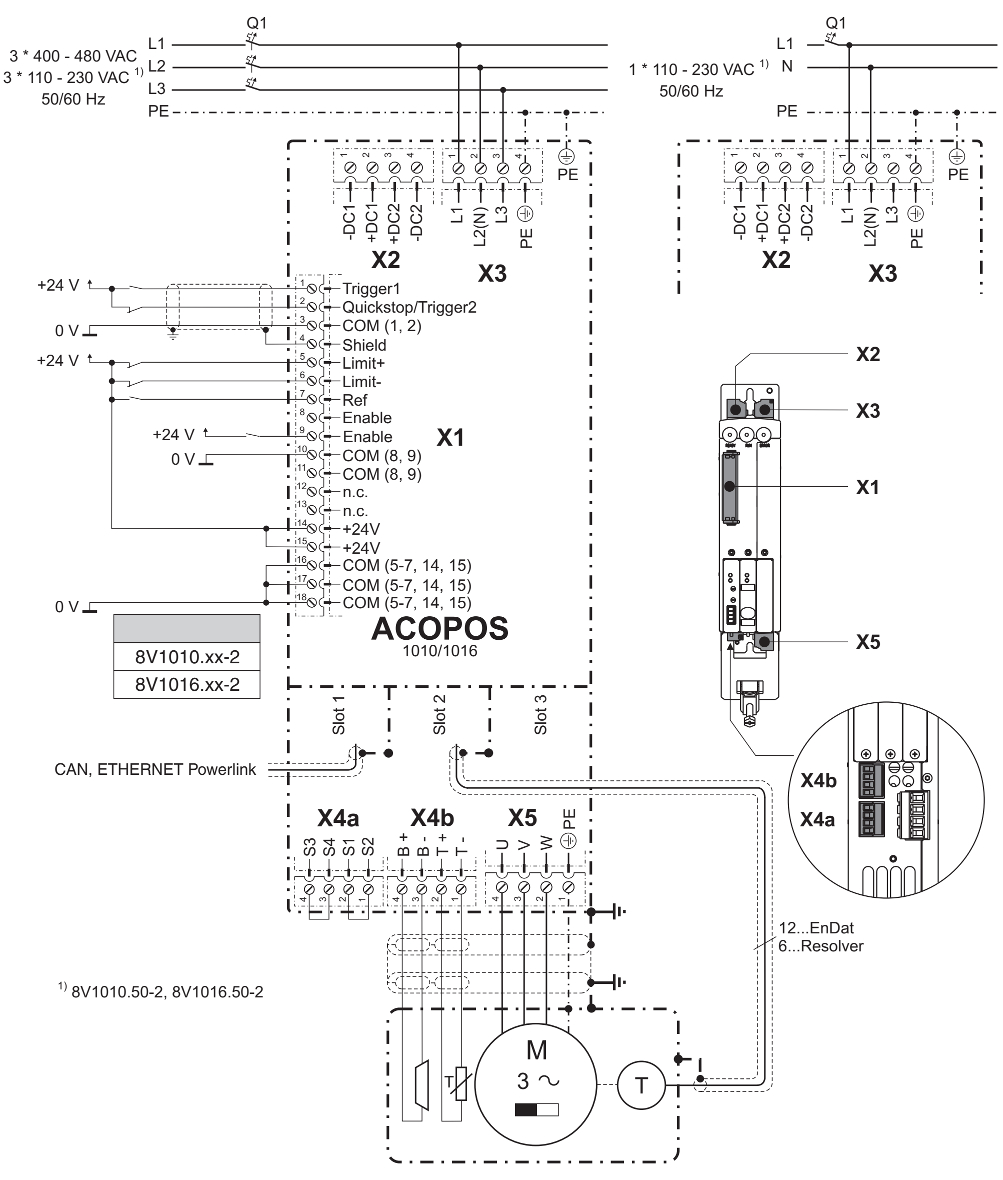

Q1
3 * 400 - 480 VAC
3 * 110 - 230 VAC 1)
50/60 Hz
L1
L2
L3
PE
Q1
1 * 110 - 230 VAC 1)
50/60 Hz
L1
N
PE
-DC1
+DC1
+DC2
-DC2
L1
L2(N)
L3
PE
X2
X3
+24 V
0 V
+24 V
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
+24 V
0 V
Enable
COM (8, 9)
COM (8, 9)
n.c.
n.c.
+24V
+24V
COM (5-7, 14, 15)
COM (5-7, 14, 15)
COM (5-7, 14, 15)
X1
0 V
8V1010.xx-2
8V1016.xx-2
ACOPOS
1010/1016
Slot 1
Slot 2
Slot 3
CAN, ETHERNET Powerlink
X4a
X4b
X5
S3
S4
S1
S2
B +
B -
T +
T -
U
V
W
PE
X2
X3
X1
X5
X4b
X4a
12...EnDat
6...Resolver
1) 8V1010.50-2, 8V1016.50-2
M
3 ~
T
T

Figure 40: Pin assignment overview ACOPOS 1010, 1016

2.1 Pin Assignments for Plug X1

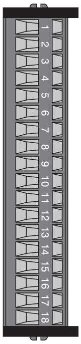
X1	Pin	Description	Function
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shielding
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	---	---
	14	+24V	Supply +24 V
	15	+24V	Supply +24 V
	16	COM (5-7, 14, 15)	Supply 0 V
	17	COM (5-7, 14, 15)	Supply 0 V
	18	COM (5-7, 14, 15)	Supply 0 V
	The following connections are linked with each other internally in the device: • Pin 8 --> Pin 9 (Enable) • Pin 10 --> Pin 11 (Enable 0 V) • Pin 14 --> Pin 15 (Supply +24 V) • Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V) Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 75: Pin assignments for plug X1 ACOPOS 1010, 1016

2.2 Pin Assignments for Plug X2

2.2.1 8V1010.00-2, 8V1016.00-2

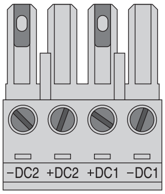
X2	Pin	Description	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 76: Pin assignments for plug X2 ACOPOS 8V1010.00-2, 8V1016.00-2

2.2.2 8V1010.50-2, 8V1016.50-2

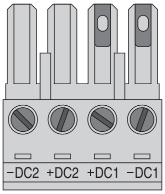
X2	Pin	Description	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 77: Pin assignments for plug X2 ACOPOS 8V1010.50-2, 8V1016.50-2

> # Warning!
>
> **Its only permitted to link DC buses for ACOPOS servo drives with the same supply voltage range (see table 60 "Supply Voltage Range for ACOPOS Servo Drives" on page 122).**
>
> **Therefore, the DC buses for ACOPOS servo drives 8Vxxxx.50-2 and 8Vxxxx.00-2 are not allowed to be linked! For this reason, the X2 plugs for ACOPOS servo drives 8Vxxxx.50-2 and 8Vxxxx.00-2 are coded differently.**

2.3 Pin Assignments for Plug X3

2.3.1 8V1010.00-2, 8V1016.00-2

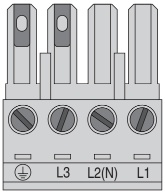
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2(N)	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 78: Pin assignments for plug X3 ACOPOS 8V1010.00-2, 8V1016.00-2

2.3.2 8V1010.50-2, 8V1016.50-2

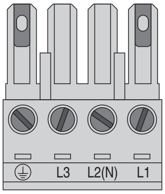
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2(N)	Power mains connection N
	3	L3	---
	4	PE	Protective ground conductor
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 79: Pin assignments for plug X3 ACOPOS 8V1010.50-2, 8V1016.50-2

2.4 Pin Assignments for Plugs X4a, X4b

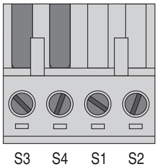
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 80: Pin assignments for plug X4a ACOPOS 1010, 1016

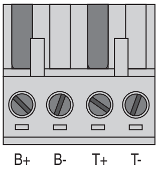
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 81: Pin assignments for plug X4b ACOPOS 1010, 1016

2.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

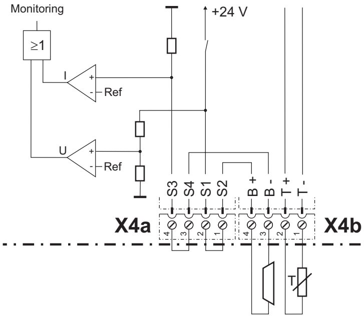
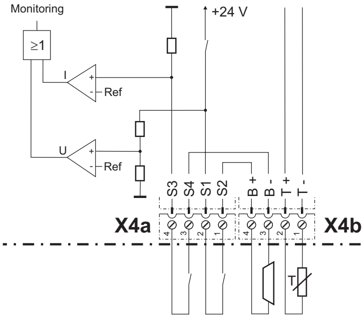
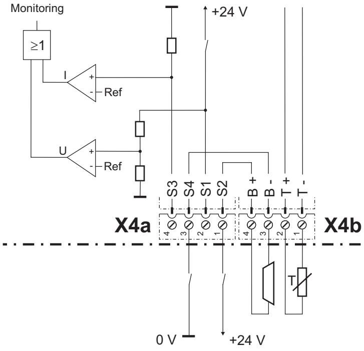
	Image	Description
1	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T	• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive • **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)
2	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T	• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential free contacts 2) • **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. 3)**
3	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T 0 V +24 V	• **Supply:** External • **Activation:** External • **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. 4)**

Table 82: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.5 Pin Assignments for Plug X5

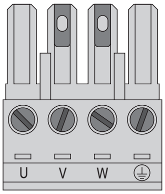
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 83: Pin assignments for plug X5 ACOPOS 1010, 1016

2.6 Protective Ground Connection (PE)

The protective ground conductor is connected to the threaded bolt M5 provided using a cable lug. For information concerning dimensioning see section 1.1.3 "Protective Ground Connection (PE)" on page 122.

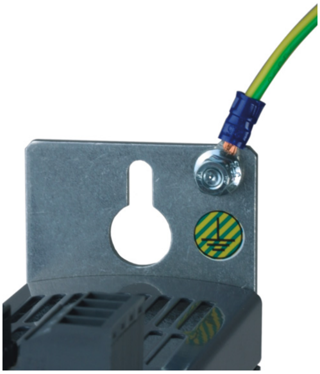
Image	Pin	Description	Function
	---	PE	Protective ground conductor
Terminal Cross Sections	[mm^2]		AWG
Cable lug for threaded bolt M5	0.25 - 16		23 - 5

Table 84: Protective ground conductor (PE) ACOPOS 1010, 1016

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

2.7 Input/Output Circuit Diagram

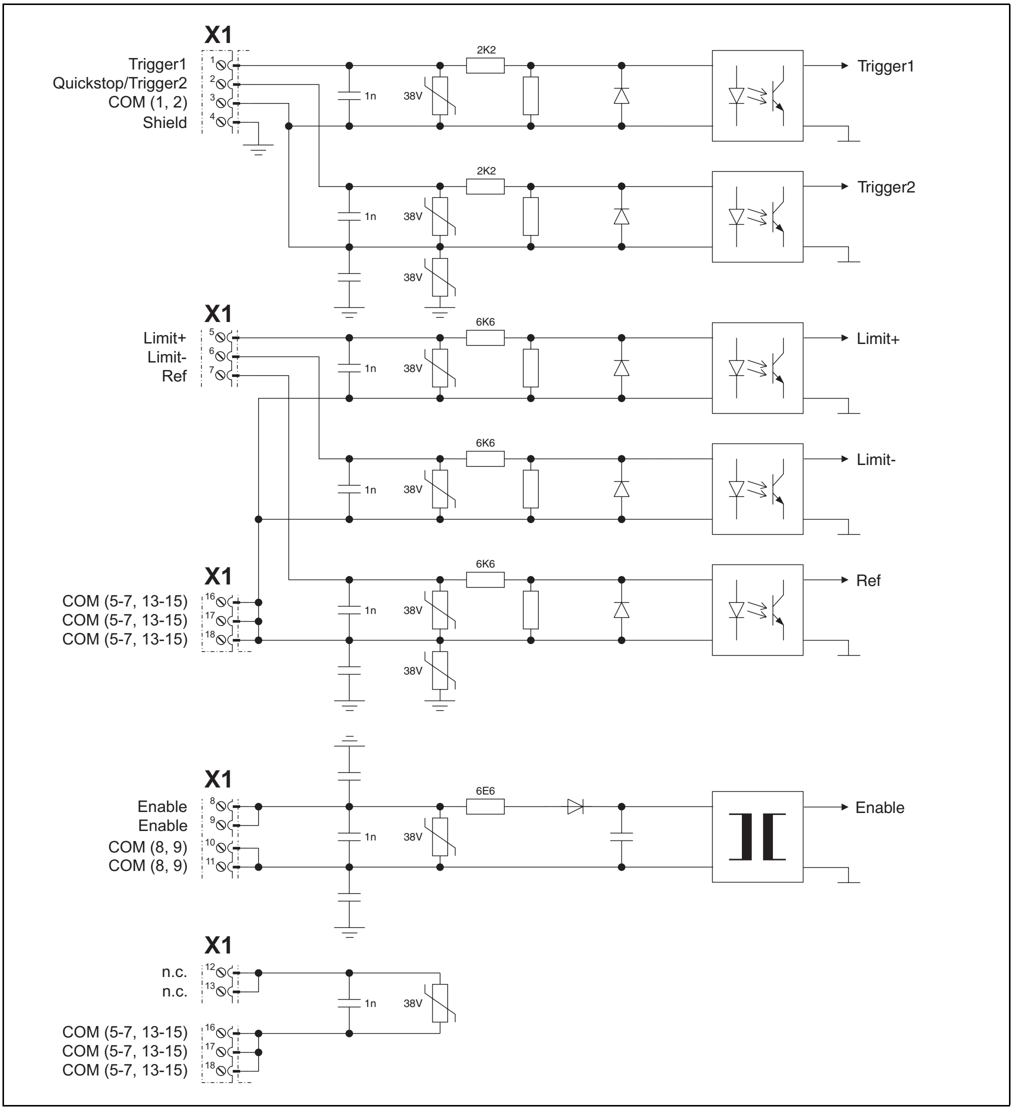

X1
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
1
2
3
4
2K2
1n
38V
Trigger1
2K2
1n
38V
38V
Trigger2
X1
Limit+
Limit-
Ref
5
6
7
6K6
1n
38V
Limit+
6K6
1n
38V
Limit-
X1
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
6K6
1n
38V
38V
Ref
X1
Enable
Enable
COM (8, 9)
COM (8, 9)
8
9
10
11
6E6
1n
38V
Enable
X1
n.c.
n.c.
12
13
1n
38V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18

Figure 41: Input/Output Circuit Diagram ACOPOS 1010, 1016

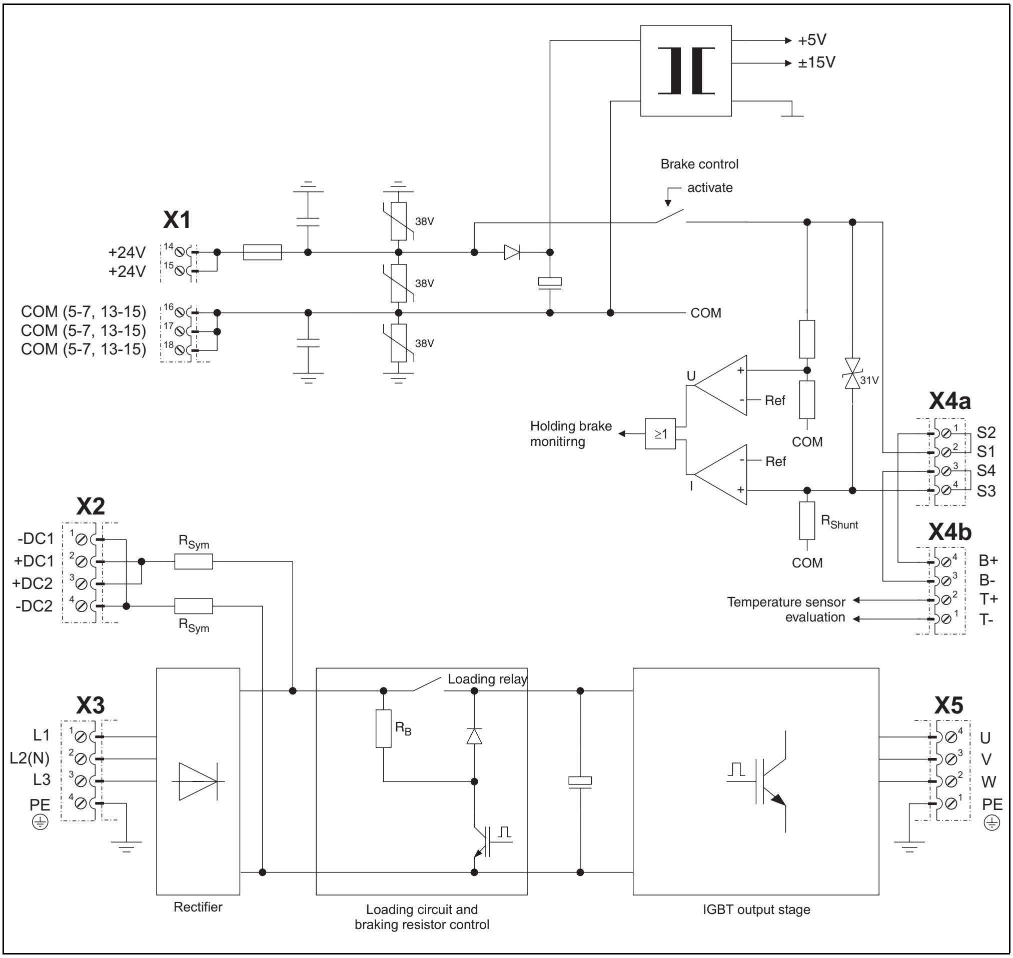

+5V
±15V
Brake control
activate
X1
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
14
15
16
17
18
38V
38V
38V
COM
U
Ref
Holding brake
monitirng
≥1
COM
Ref
I
31V
X4a
S2
S1
S4
S3
R_{Shunt}
COM
X4b
B+
B-
T+
T-
Temperature sensor
evaluation
X2
-DC1
+DC1
+DC2
-DC2
R_{Sym}
R_{Sym}
X3
L1
L2(N)
L3
PE
Loading relay
R_B
X5
U
V
W
PE
Rectifier
Loading circuit and
braking resistor control
IGBT output stage

Figure 41: Input/Output Circuit Diagram ACOPOS 1010, 1016 (Forts.)

3. Pin Assignments ACOPOS 1022, 1045, 1090 [1]

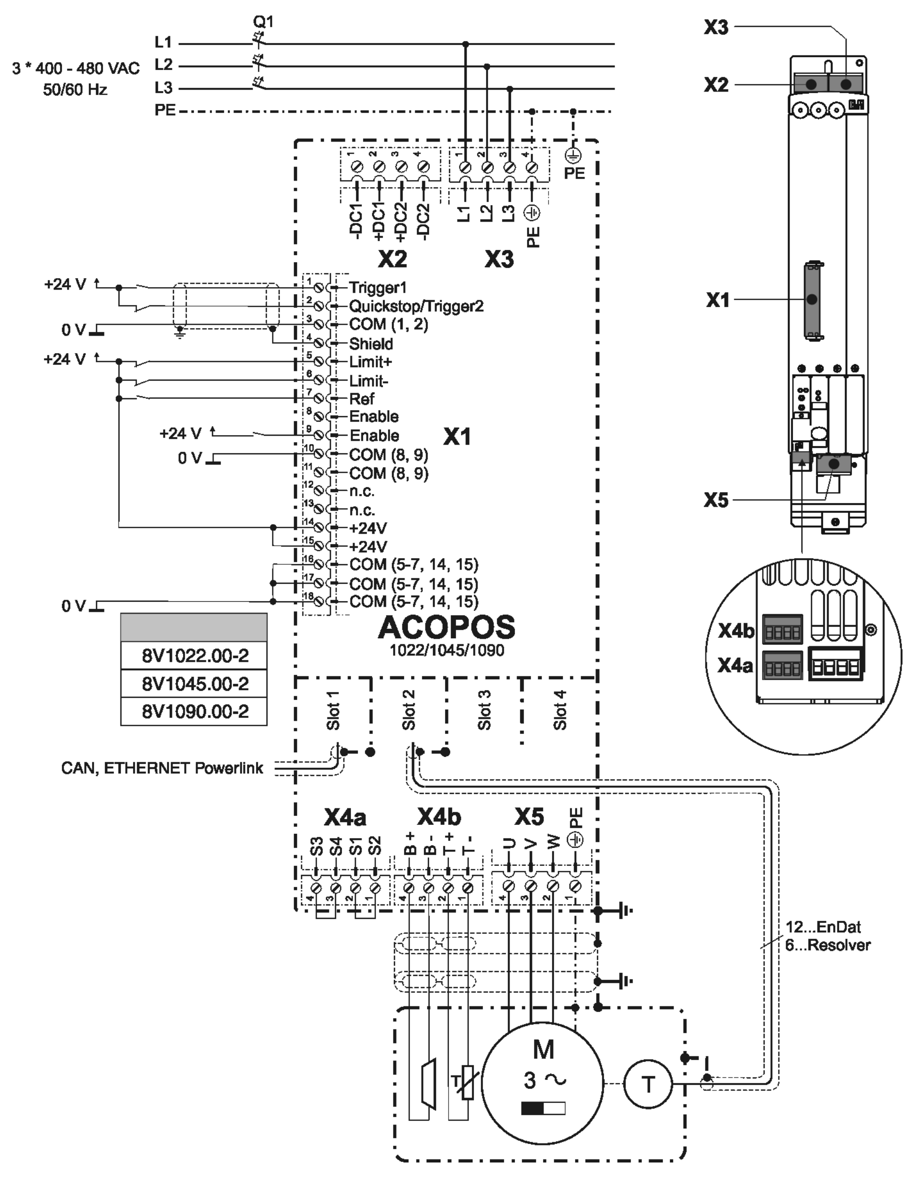
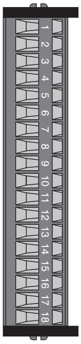

Q1
L1
L2
L3
PE
3 * 400 - 480 VAC
50/60 Hz
X3
X2
X1
X5
X4b
X4a
-DC1
+DC1
+DC2
-DC2
L1
L2
L3
PE
X2
X3
+24 V
0 V
+24 V
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
Enable
+24 V
0 V
COM (8, 9)
COM (8, 9)
n.c.
n.c.
+24V
+24V
COM (5-7, 14, 15)
COM (5-7, 14, 15)
COM (5-7, 14, 15)
0 V
X1
ACOPOS
1022/1045/1090
8V1022.00-2
8V1045.00-2
8V1090.00-2
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink
X4a
X4b
X5
S3
S4
S1
S2
B +
B -
T +
T -
U
V
W
PE
12...EnDat
6...Resolver
M
3 ~
T

Figure 42: Pin assignment overview ACOPOS 1022, 1045, 1090

---

[1] Starting with revision I0.

3.1 Pin Assignments for Plug X1

X1	Pin	Description	Function
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shielding
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	---	---
	14	+24V	Supply +24 V
	15	+24V	Supply +24 V
	16	COM (5-7, 14, 15)	Supply 0 V
	17	COM (5-7, 14, 15)	Supply 0 V
	18	COM (5-7, 14, 15)	Supply 0 V

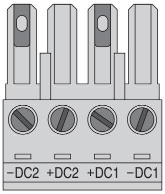
The following connections are linked with each other internally in the device:

- Pin 8 --> Pin 9 (Enable)
- Pin 10 --> Pin 11 (Enable 0 V)
- Pin 14 --> Pin 15 (Supply +24 V)
- Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V)

Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.

Table 85: Pin assignments for plug X1 ACOPOS 1022, 1045, 1090

3.2 Pin Assignments for Plug X2

X2	Pin	Description	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -

Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.

Table 86: Pin assignments for plug X2 ACOPOS 1022, 1045, 1090

3.3 Pin Assignments for Plug X3

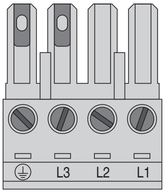
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 87: Pin assignments for plug X3 ACOPOS 1022, 1045, 1090

3.4 Pin Assignments for Plugs X4a, X4b

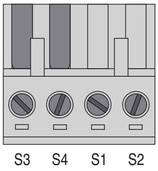
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 88: Pin assignments for plug X4a ACOPOS 1022, 1045, 1090

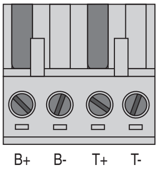
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 89: Pin assignments for plug X4b ACOPOS 1022, 1045, 1090

3.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

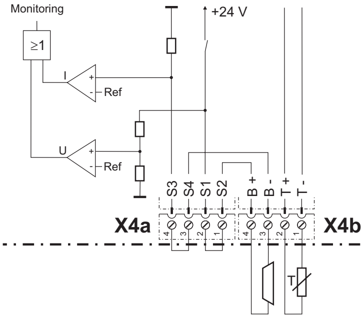
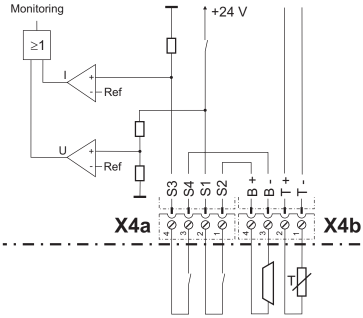
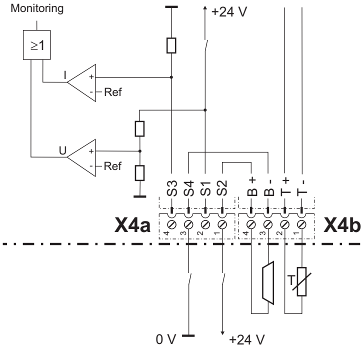
	Image	Description
1	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a 4 3 2 1 4 3 2 1 X4b T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive - **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. [1]
2	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a 4 3 2 1 4 3 2 1 X4b T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential free contacts [2] - **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. [3]**
3	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a 4 3 2 1 4 3 2 1 X4b T 0 V +24 V	- **Supply:** External - **Activation:** External - **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. [4]**

Table 90: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

3.5 Pin Assignments for Plug X5

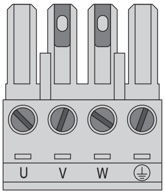
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 91: Pin assignments for plug X5 ACOPOS 1022, 1045, 1090

3.6 Protective Ground Connection (PE)

The protective ground conductor is connected to the threaded bolt M5 provided using a cable lug. For information concerning dimensioning see section 1.1.3 "Protective Ground Connection (PE)" on page 122.

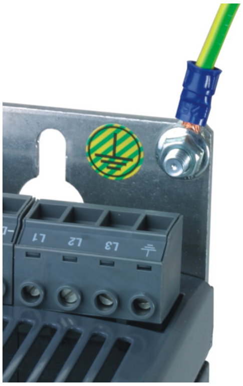
Image	Pin	Description	Function
	---	PE	Protective ground conductor
Terminal Cross Sections	**[mm²]**		**AWG**
Cable lug for threaded bolt M5	0.25 - 16		23 - 5

Table 92: Protective ground conductor (PE) ACOPOS 1022, 1045, 1090

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

3.7 Input/Output Circuit Diagram

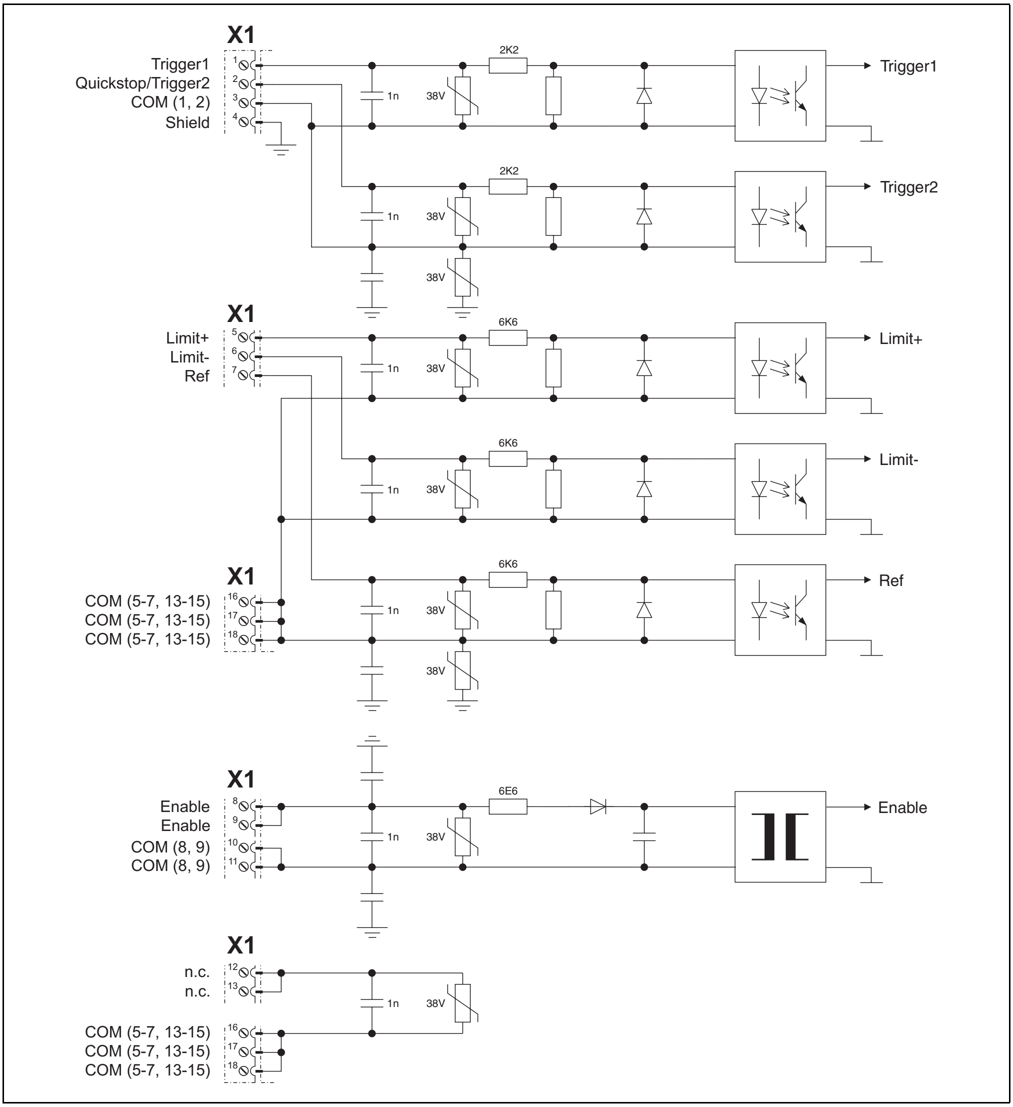

X1
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
1
2
3
4
2K2
1n
38V
Trigger1
2K2
1n
38V
38V
Trigger2
X1
Limit+
Limit-
Ref
5
6
7
6K6
1n
38V
Limit+
6K6
1n
38V
Limit-
X1
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
6K6
1n
38V
38V
Ref
X1
Enable
Enable
COM (8, 9)
COM (8, 9)
8
9
10
11
6E6
1n
38V
Enable
X1
n.c.
n.c.
12
13
1n
38V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18

Figure 43: Input/Output Circuit Diagram ACOPOS 1022, 1045, 1090

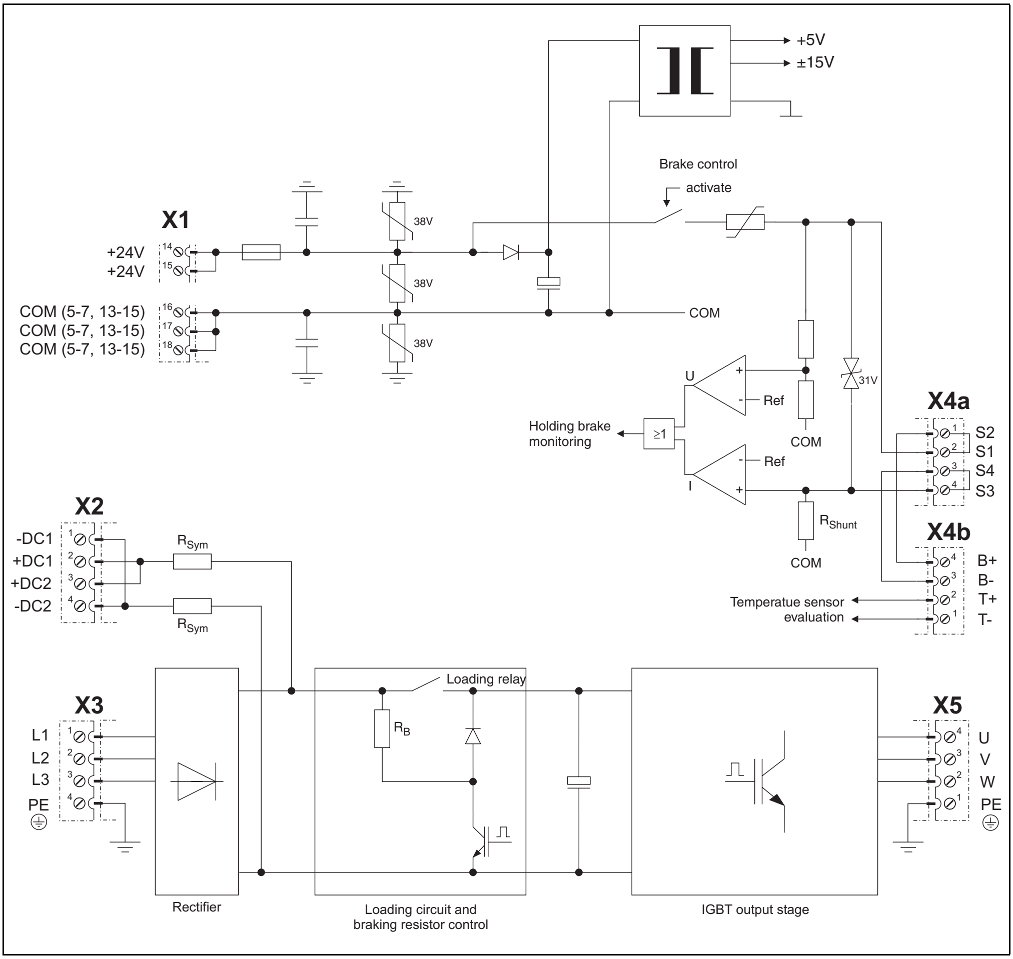

+5V
±15V
Brake control
activate
X1
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
14
15
16
17
18
38V
38V
38V
COM
U
Ref
COM
31V
X4a
S2
S1
S4
S3
Holding brake
monitoring
≥1
Ref
I
R_{Shunt}
COM
X4b
B+
B-
T+
T-
Temperatue sensor
evaluation
X2
-DC1
+DC1
+DC2
-DC2
R_{Sym}
R_{Sym}
X3
L1
L2
L3
PE
Loading relay
R_B
X5
U
V
W
PE
Rectifier
Loading circuit and
braking resistor control
IGBT output stage

Figure 43: Input/Output Circuit Diagram ACOPOS 1022, 1045, 1090 (Forts.)

4. Pin Assignments ACOPOS 1180, 1320 [1]

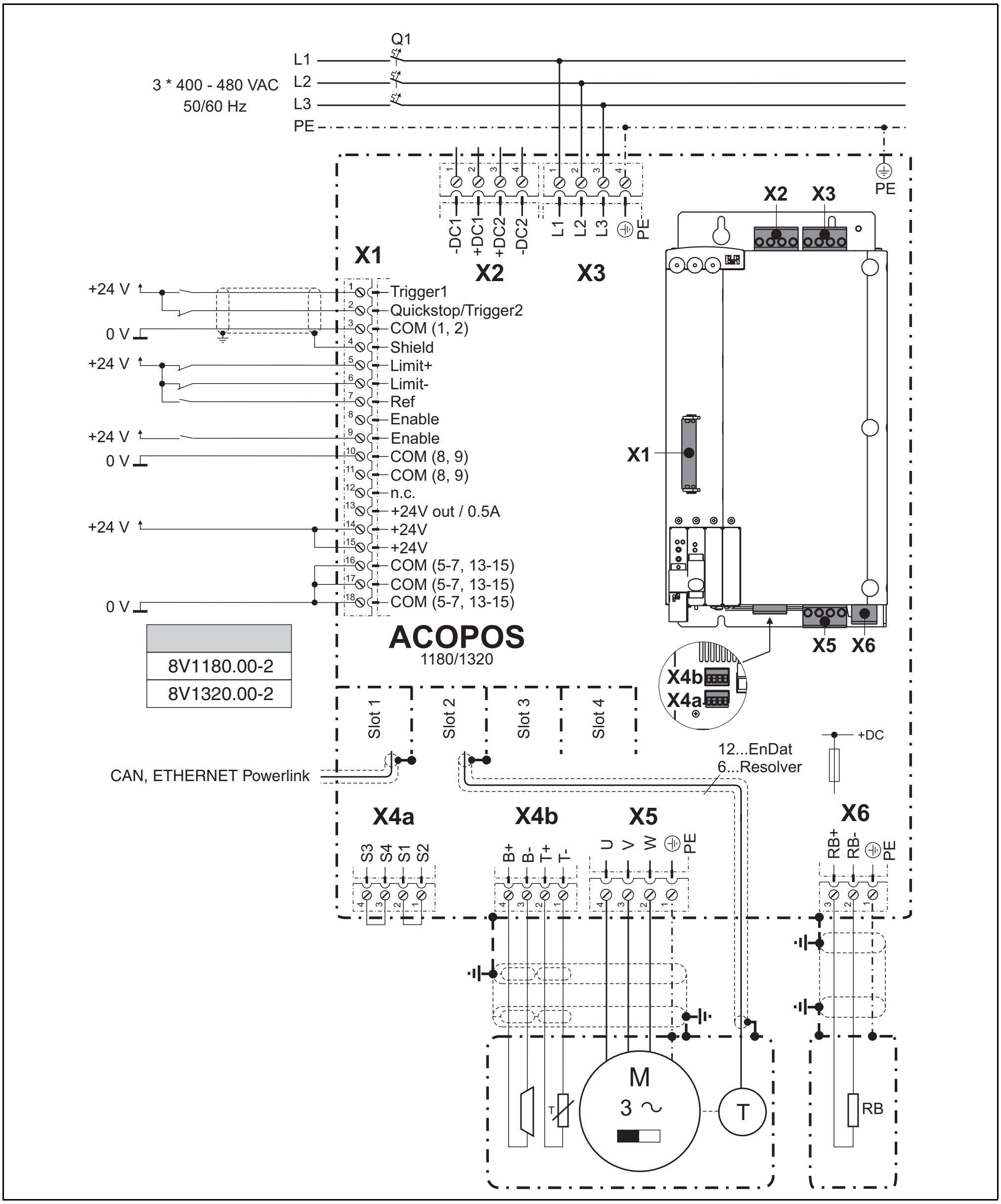
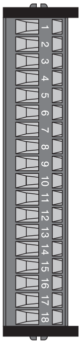

Q1
3 * 400 - 480 VAC
50/60 Hz
L1
L2
L3
PE
-DC1
+DC1
+DC2
-DC2
L1
L2
L3
PE
X1
X2
X3
X2
X3
PE
+24 V
0 V
+24 V
+24 V
0 V
+24 V
0 V
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
Limit+
Limit-
Ref
Enable
Enable
COM (8, 9)
COM (8, 9)
n.c.
+24V out / 0.5A
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
X1
8V1180.00-2
8V1320.00-2
ACOPOS
1180/1320
X5
X6
X4b
X4a
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink
12...EnDat
6...Resolver
+DC
X4a
S3
S4
S1
S2
X4b
B+
B-
T+
T-
X5
U
V
W
PE
X6
RB+
RB-
PE
M
3 ~
T
T
RB

Figure 44: Pin assignment overview ACOPOS 1180, 1320

---

[1] Starting with revision F0.

4.1 Pin Assignments for Plug X1

<table>
<tr><th>X1</th><th>Pin</th><th>Description</th><th>Function</th></tr>
<tr><td rowspan="19">

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

</td><td>1</td><td>Trigger1</td><td>Trigger 1</td></tr>
<tr><td>2</td><td>Quickstop/Trigger2</td><td>Quickstop/Trigger 2</td></tr>
<tr><td>3</td><td>COM (1, 2)</td><td>Trigger 1, Quickstop/Trigger 2 - 0 V</td></tr>
<tr><td>4</td><td>Shield</td><td>Shielding</td></tr>
<tr><td>5</td><td>Limit+</td><td>Positive HW limit</td></tr>
<tr><td>6</td><td>Limit-</td><td>Negative HW limit</td></tr>
<tr><td>7</td><td>Ref</td><td>Reference switch</td></tr>
<tr><td>8</td><td>Enable</td><td>Enable</td></tr>
<tr><td>9</td><td>Enable</td><td>Enable</td></tr>
<tr><td>10</td><td>COM (8, 9)</td><td>Enable 0 V</td></tr>
<tr><td>11</td><td>COM (8, 9)</td><td>Enable 0 V</td></tr>
<tr><td>12</td><td>---</td><td>---</td></tr>
<tr><td>13</td><td>+24V out / 0.5A</td><td>+24 V output / 0.5 A</td></tr>
<tr><td>14</td><td>+24V</td><td>Supply +24 V</td></tr>
<tr><td>15</td><td>+24V</td><td>Supply +24 V</td></tr>
<tr><td>16</td><td>COM (5-7, 13-15)</td><td>Supply 0 V</td></tr>
<tr><td>17</td><td>COM (5-7, 13-15)</td><td>Supply 0 V</td></tr>
<tr><td>18</td><td>COM (5-7, 13-15)</td><td>Supply 0 V</td></tr>
<tr><td colspan="3">The following connections are linked with each other internally in the device:
• Pin 8 --> Pin 9 (Enable)
• Pin 10 --> Pin 11 (Enable 0 V)
• Pin 14 --> Pin 15 (Supply +24 V)
• Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V)
Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.</td></tr>
</table>

Table 93: Pin assignments for plug X1 ACOPOS 1180, 1320

4.2 Pin Assignments for Plug X2

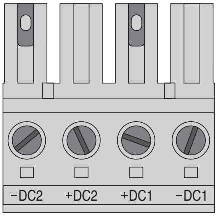
<table>
<tr><th>X2</th><th>Pin</th><th>Description</th><th>Function</th></tr>
<tr><td rowspan="5"> </td><td>1</td><td>-DC1</td><td>U DC bus -</td></tr>
<tr><td>2</td><td>+DC1</td><td>U DC bus +</td></tr>
<tr><td>3</td><td>+DC2</td><td>U DC bus +</td></tr>
<tr><td>4</td><td>-DC2</td><td>U DC bus -</td></tr>
<tr><td colspan="3">Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.</td></tr>
</table>

Table 94: Pin assignments for plug X2 ACOPOS 1180, 1320

4.3 Pin Assignments for Plug X3

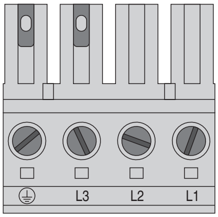
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 95: Pin assignments for plug X3 ACOPOS 1180, 1320

4.4 Pin Assignments for Plugs X4a, X4b

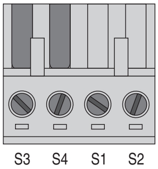
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 96: Pin assignments for plug X4a ACOPOS 1180, 1320

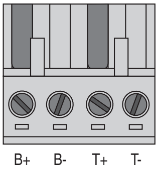
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 97: Pin assignments for plug X4b ACOPOS 1180, 1320

4.4.1 Wiring the output for the motor holding brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

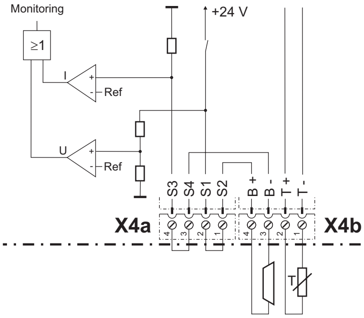
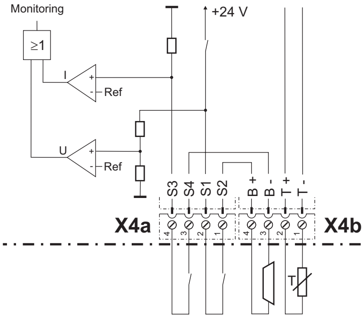
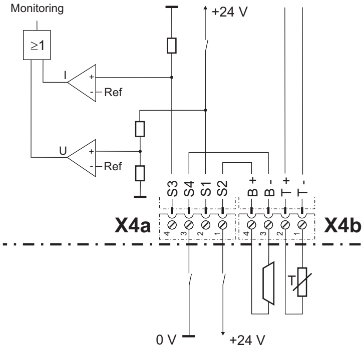
Image		Description
1	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive - **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)
2	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential free contacts 2) - **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. 3)**
3	 Monitoring ≥1 I Ref U Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 T 0 V +24 V	- **Supply:** External - **Activation:** External - **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. 4)**

Table 98: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

4.5 Pin Assignments for Plug X5

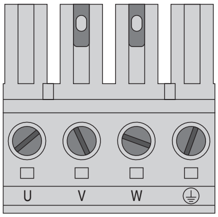
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 99: Pin assignments for plug X5 ACOPOS 1180, 1320

4.6 Pin Assignments for Plug X6

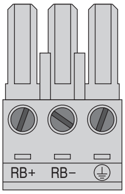
X6	Pin	Description	Function
	1	PE	Protective ground conductor
	2	RB-	Brake Resistance -
	3	RB+	Brake Resistance +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 100: Pin assignments for plug X6 ACOPOS 1180, 1320

4.7 Protective Ground Connection (PE)

The protective ground conductor is connected to the threaded bolt M5 provided using a cable lug. For information concerning dimensioning see section 1.1.3 "Protective Ground Connection (PE)" on page 122.

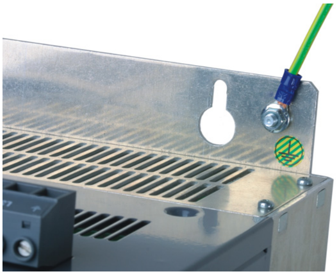
<table>
<tr><th>Image</th><th>Pin</th><th>Description</th><th>Function</th></tr>
<tr><td></td><td>---</td><td>PE</td><td>Protective ground conductor</td></tr>
<tr><th>Terminal Cross Sections</th><th colspan="2">[mm^2]</th><th>AWG</th></tr>
<tr><td>Cable lug for threaded bolt M5</td><td colspan="2">0.25 - 16</td><td>23 - 5</td></tr>
</table>

Table 101: Protective ground conductor (PE) ACOPOS 1180, 1320

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

4.8 Input/Output Circuit Diagram

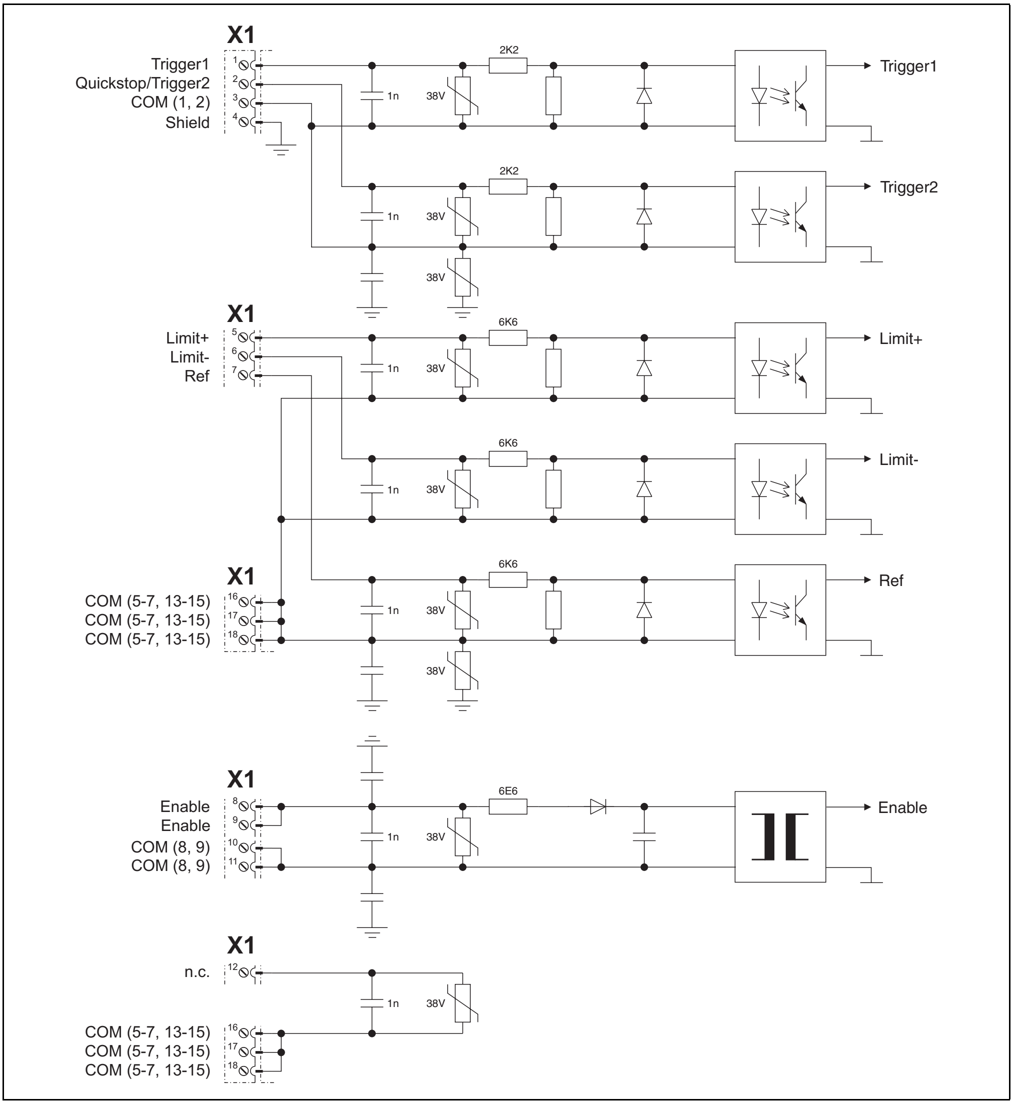

X1
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
1
2
3
4
2K2
1n
38V
Trigger1
2K2
1n
38V
38V
Trigger2
X1
Limit+
Limit-
Ref
5
6
7
6K6
1n
38V
Limit+
6K6
1n
38V
Limit-
X1
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
6K6
1n
38V
38V
Ref
X1
Enable
Enable
COM (8, 9)
COM (8, 9)
8
9
10
11
6E6
1n
38V
Enable
X1
n.c.
12
1n
38V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18

Figure 45: Input/Output Circuit Diagram ACOPOS 1180, 1320

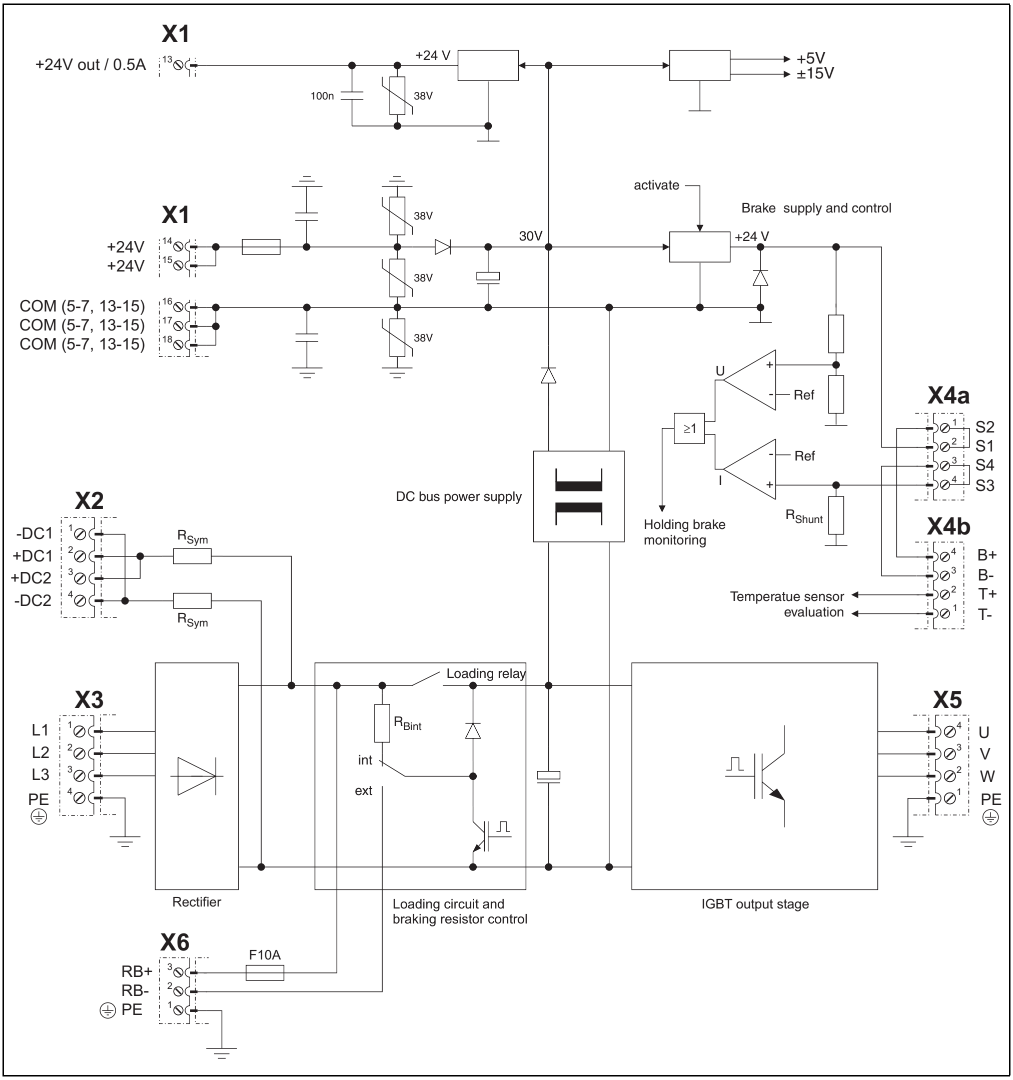
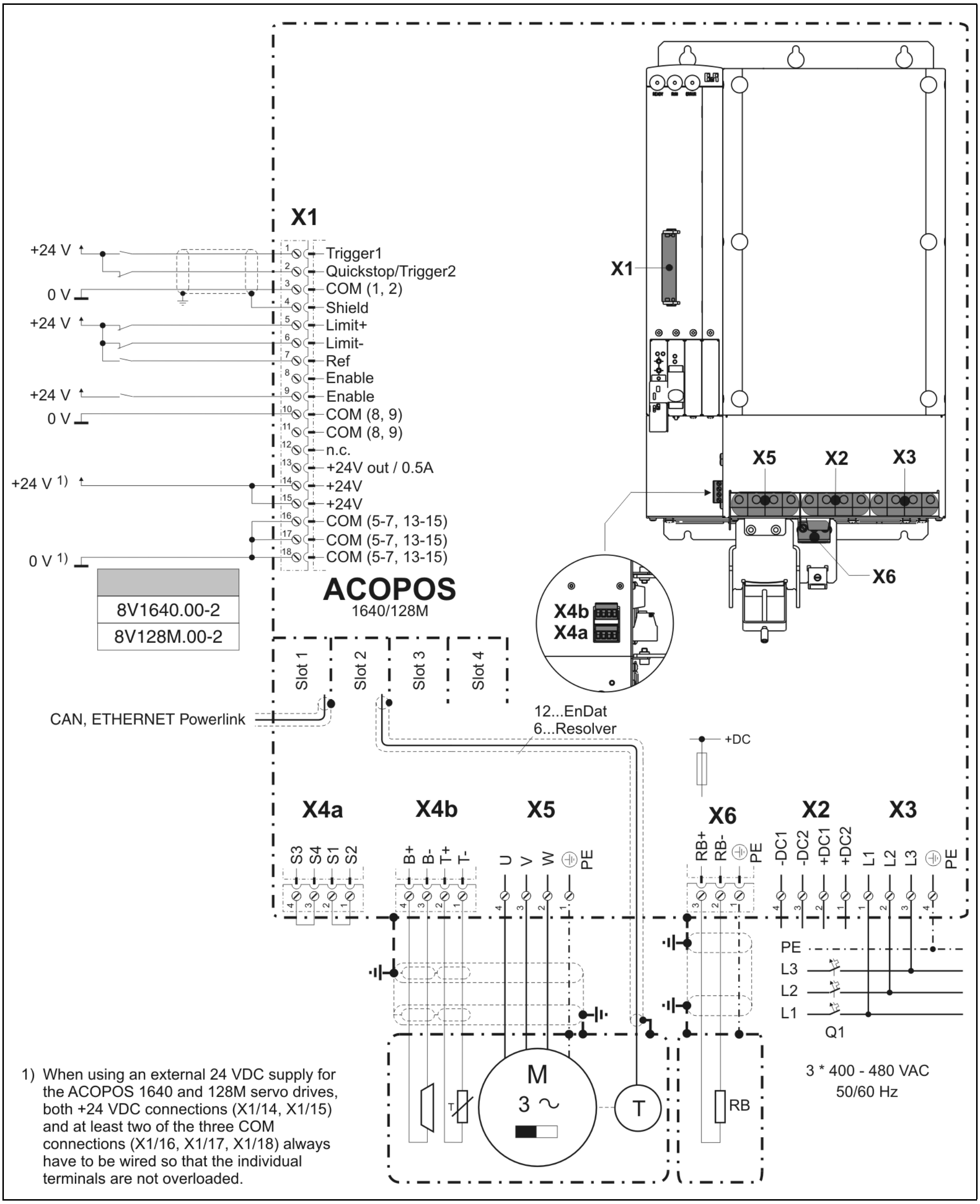

X1
+24V out / 0.5A
13
+24 V
100n
38V
+5V
±15V
activate
Brake supply and control
X1
+24V
+24V
14
15
38V
30V
+24 V
38V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
38V
U
Ref
X4a
≥1
Ref
I
S2
S1
S4
S3
DC bus power supply
X2
-DC1
+DC1
+DC2
-DC2
RSym
RSym
Holding brake monitoring
RShunt
X4b
B+
B-
T+
T-
Temperatue sensor evaluation
Loading relay
X3
L1
L2
L3
PE
RBint
int
ext
X5
U
V
W
PE
Rectifier
Loading circuit and braking resistor control
IGBT output stage
X6
F10A
RB+
RB-
PE

Figure 45: Input/Output Circuit Diagram ACOPOS 1180, 1320 (Forts.)

5. Pin Assignments ACOPOS 1640, 128M [1]


X1
+24 V
0 V
+24 V
+24 V
0 V
+24 V 1)
0 V 1)
1 Trigger1
2 Quickstop/Trigger2
3 COM (1, 2)
4 Shield
5 Limit+
6 Limit-
7 Ref
8 Enable
9 Enable
10 COM (8, 9)
11 COM (8, 9)
12 n.c.
13 +24V out / 0.5A
14 +24V
15 +24V
16 COM (5-7, 13-15)
17 COM (5-7, 13-15)
18 COM (5-7, 13-15)
8V1640.00-2
8V128M.00-2
ACOPOS
1640/128M
X1
X5
X2
X3
X6
X4b
X4a
Slot 1
Slot 2
Slot 3
Slot 4
CAN, ETHERNET Powerlink
12...EnDat
6...Resolver
+DC
X4a
S3 S4 S1 S2
X4b
B+ B- T+ T-
X5
U V W PE
X6
RB+ RB- PE
X2
-DC1 -DC2 +DC1 +DC2
X3
L1 L2 L3 PE
PE
L3
L2
L1
Q1
3 * 400 - 480 VAC
50/60 Hz
M
3 ~
T
T
RB

1) When using an external 24 VDC supply for the ACOPOS 1640 and 128M servo drives, both +24 VDC connections (X1/14, X1/15) and at least two of the three COM connections (X1/16, X1/17, X1/18) always have to be wired so that the individual terminals are not overloaded.

Figure 46: Pin assignment overview ACOPOS 1640, 128M

---

[1] Starting with revision K0.

5.1 Pin Assignments for Plug X1

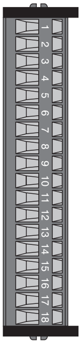
X1	Pin	Description	Function
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shielding
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	+24V out / 0.5A	+24 V output / 0.5 A
	14	+24V	Supply +24 V 1)
	15	+24V	Supply +24 V 1)
	16	COM (5-7, 13-15)	Supply 0 V 1)
	17	COM (5-7, 13-15)	Supply 0 V 1)
	18	COM (5-7, 13-15)	Supply 0 V 1)
	The following connections are linked with each other internally in the device: • Pin 8 --> Pin 9 (Enable) • Pin 10 --> Pin 11 (Enable 0 V) • Pin 14 --> Pin 15 (Supply +24 V) • Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V) Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 102: Pin assignments for plug X1 ACOPOS 1640, 128M

1) When using an external 24 VDC supply for the ACOPOS 1640 and 128M servo drives, both +24 VDC connections (X1/14, X1/15) and at least two of the three COM connections (X1/16, X1/17, X1/18) always have to be wired so that the individual terminals are not overloaded.

5.2 Pin Assignments X2

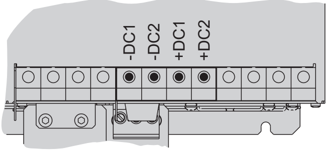
X2	Pin	Description	Function
	1	+DC2	U DC bus +
	2	+DC1	U DC bus +
	3	-DC2	U DC bus -
	4	-DC1	U DC bus -
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 103: Pin assignments for X2 ACOPOS 1640, 128M

5.3 Pin Assignments X3

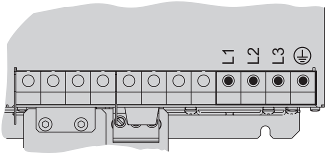
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	⏚	Protective ground conductor
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 104: Pin assignments for X3 ACOPOS 1640, 128M

5.4 Pin Assignments for Plugs X4a, X4b

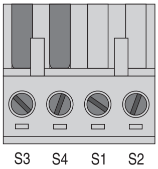
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 105: Pin assignments for plug X4a ACOPOS 1640, 128M

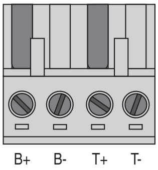
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 106: Pin assignments for plug X4b ACOPOS 1640, 128M

5.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

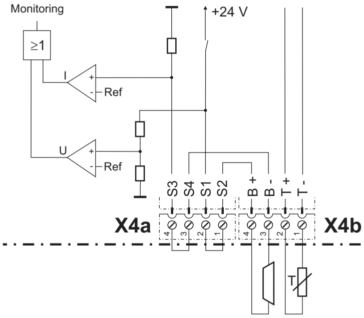
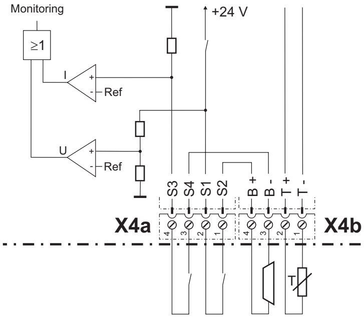
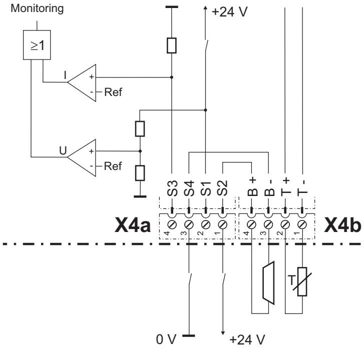
	Image	Description
1	 Monitoring ≥1 I U Ref Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 4 3 2 1 T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive - **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)
2	 Monitoring ≥1 I U Ref Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 4 3 2 1 T	- **Supply:** Internally by the ACOPOS servo drive - **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential free contacts 2) - **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. 3)**
3	 Monitoring ≥1 I U Ref Ref +24 V S3 S4 S1 S2 B + B - T + T - X4a X4b 4 3 2 1 4 3 2 1 T 0 V +24 V	- **Supply:** External - **Activation:** External - **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. 4)**

Table 107: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

5.5 Pin Assignments X5

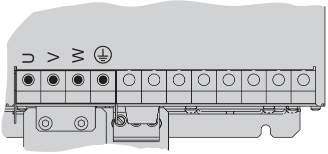
X5	Pin	Description	Function
	1	⏚	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 108: Pin assignments for X5 ACOPOS 1640, 128M

5.6 Pin assignments X6

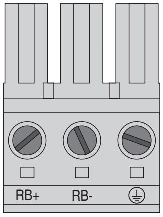
X6	Pin	Description	Function
	1	PE	Protective ground conductor
	2	RB-	Brake Resistance -
	3	RB+	Brake Resistance +
	Terminal Cross Sections see table 74 "Terminal cross sections for ACOPOS servo drives" on page 165.		

Table 109: Pin assignments for X6 ACOPOS 1640, 128M

5.7 Input/Output Circuit Diagram

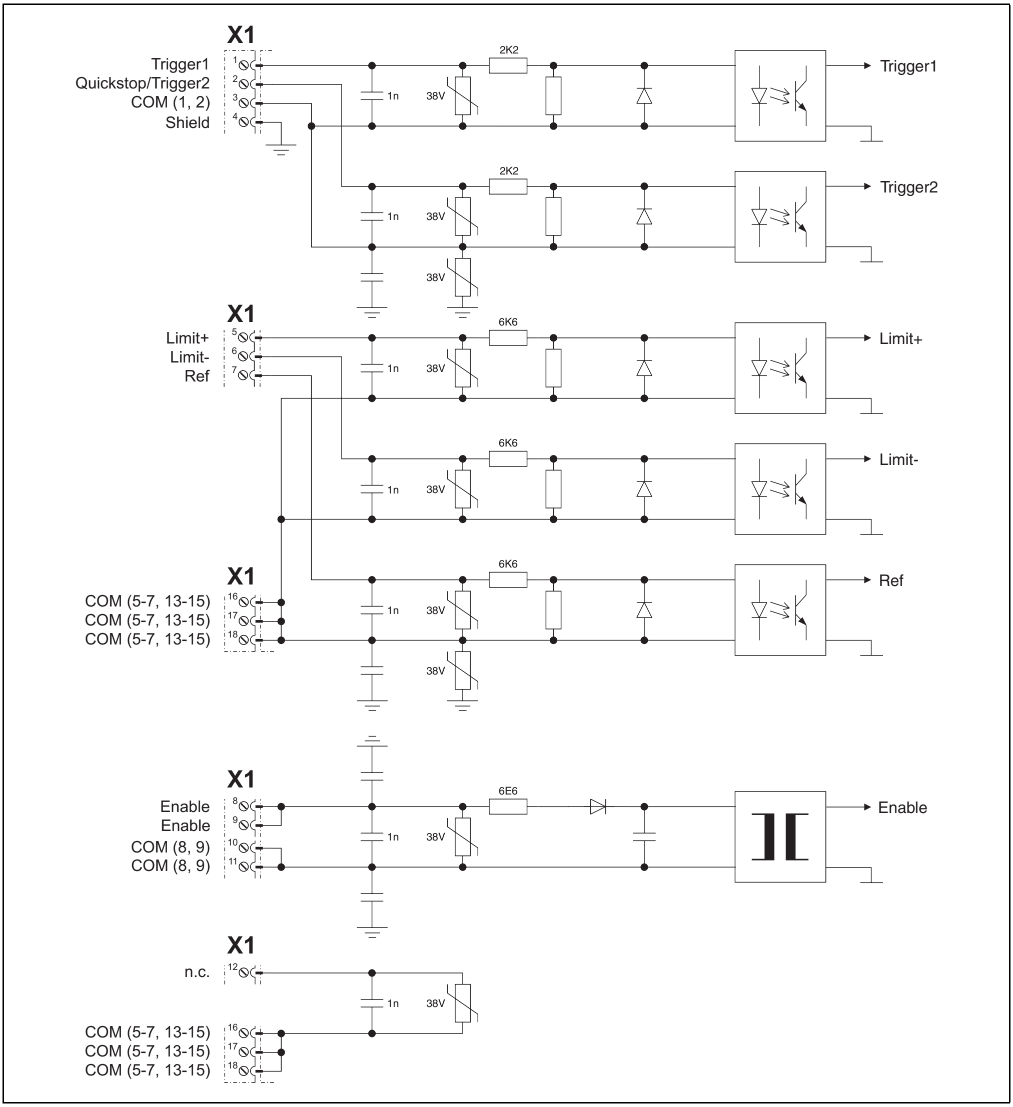

X1
Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
1
2
3
4
2K2
1n
38V
Trigger1
2K2
1n
38V
Trigger2
38V
X1
Limit+
Limit-
Ref
5
6
7
6K6
1n
38V
Limit+
6K6
1n
38V
Limit-
X1
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
6K6
1n
38V
Ref
38V
X1
Enable
Enable
COM (8, 9)
COM (8, 9)
8
9
10
11
6E6
1n
38V
Enable
X1
n.c.
12
1n
38V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18

Figure 47: Input/Output Circuit Diagram ACOPOS 1640, 128M

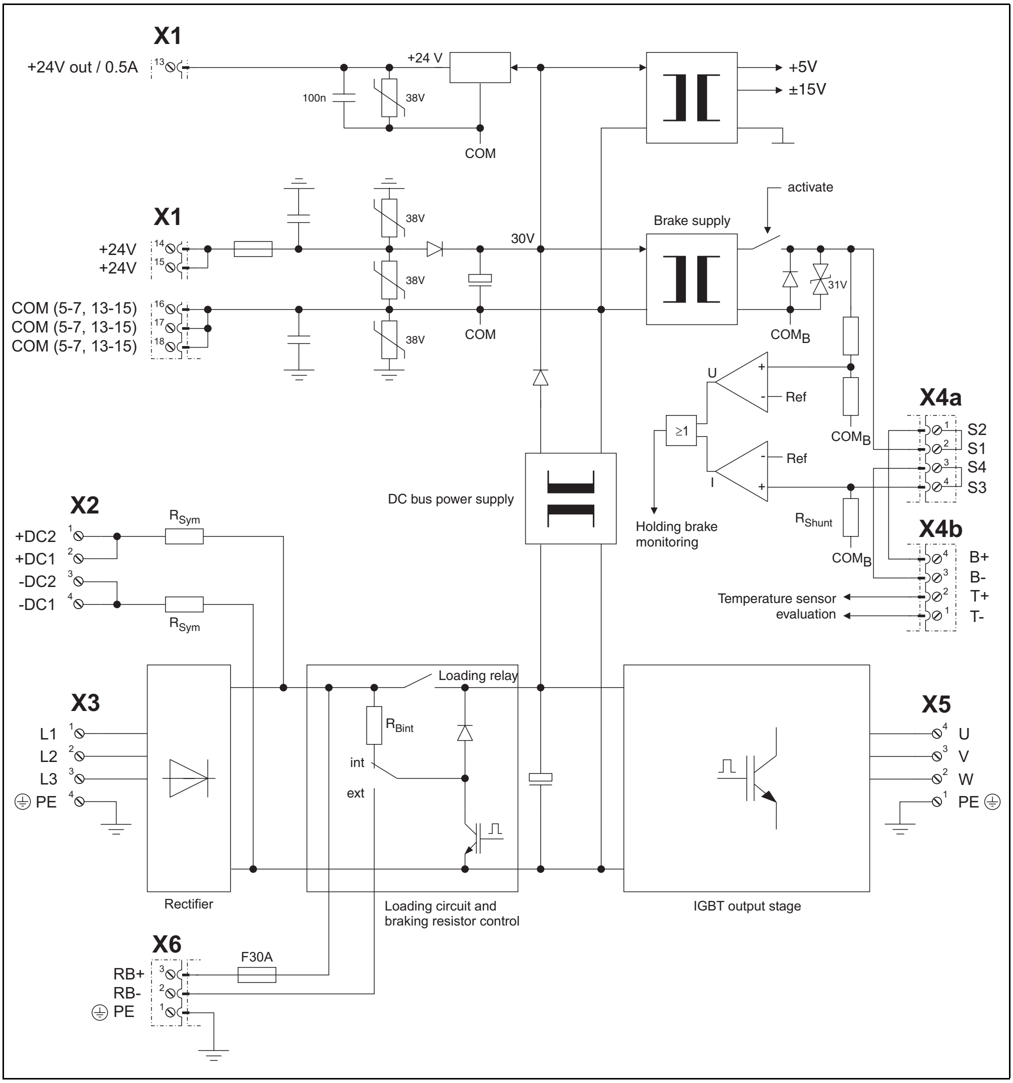

X1
+24V out / 0.5A
13
+24 V
100n
38V
COM
+5V
±15V
activate
X1
+24V
+24V
14
15
38V
38V
30V
Brake supply
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)
16
17
18
38V
COM
31V
COMB
U
Ref
≥1
COMB
Ref
I
X4a
S2
S1
S4
S3
DC bus power supply
Holding brake monitoring
RShunt
COMB
X4b
B+
B-
T+
T-
Temperature sensor evaluation
X2
RSym
+DC2
+DC1
-DC2
-DC1
RSym
Loading relay
X3
L1
L2
L3
PE
RBint
int
ext
X5
U
V
W
PE
Rectifier
Loading circuit and braking resistor control
IGBT output stage
X6
F30A
RB+
RB-
PE

Figure 47: Input/Output Circuit Diagram ACOPOS 1640, 128M (Forts.)

6. Pin Assignments Plug-in Modules

6.1 AC110 - CAN Interface

6.1.1 Pin Assignments

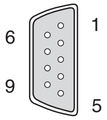
Image	X1	Pin	Description	Function
AC 110 RXD TXD		1	---	---
		2	CAN_L	CAN Low
		3	COM (2, 7)	CAN 0 V
		4	---	---
		5	---	---
		6	---	---
		7	CAN_H	CAN High
		8	---	---
		9	---	---

Table 110: Pin assignments for AC110 - CAN Interface

6.1.2 Input/Output Circuit Diagram

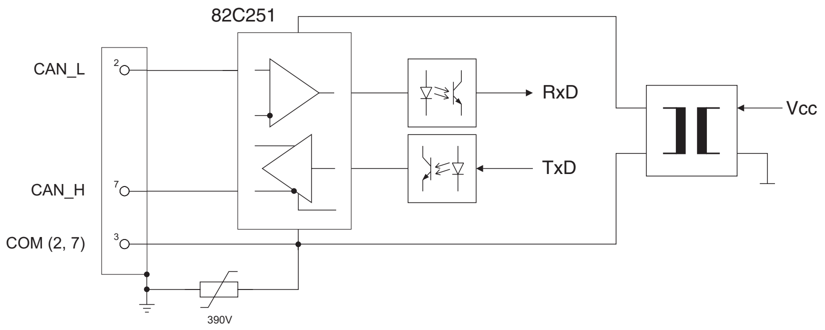

82C251
CAN_L
2
CAN_H
7
COM (2, 7)
3
RxD
TxD
Vcc
390V

Figure 48: Input/Output Circuit Diagram AC110

6.2 AC112 - ETHERNET Powerlink Interface

6.2.1 Pin Assignments

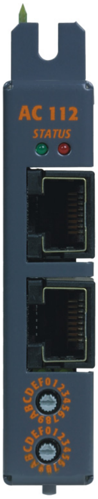
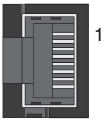
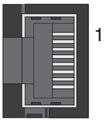
Image	X1	Pin	Description	Function
		1	RXD	Receive Signal
		2	RXD\	Receive Signal Inverted
		3	TXD	Transmit Signal
		4	Shield	Shielding
		5	Shield	Shielding
		6	TXD\	Transmit Signal Inverted
		7	Shield	Shielding
		8	Shield	Shielding
	X2	**Pin**	**Description**	**Function**
		1	RXD	Receive Signal
		2	RXD\	Receive Signal Inverted
		3	TXD	Transmit Signal
		4	Shield	Shielding
		5	Shield	Shielding
		6	TXD\	Transmit Signal Inverted
		7	Shield	Shielding
		8	Shield	Shielding

Table 111: Pin assignments for AC112 - ETHERNET Powerlink Interface

Information:

In general, crossover Ethernet cables must be used for ETHERNET Powerlink connections!

Take care when plugging the cable in and out because otherwise the shield connection could break between the RJ45 plug and the cable shield which could then cause connection disturbances!

Information:

ETHERNET Powerlink cables must have crossover pin assignments. Unassigned wires cannot be omitted.

6.2.2 Input/Output Circuit Diagram

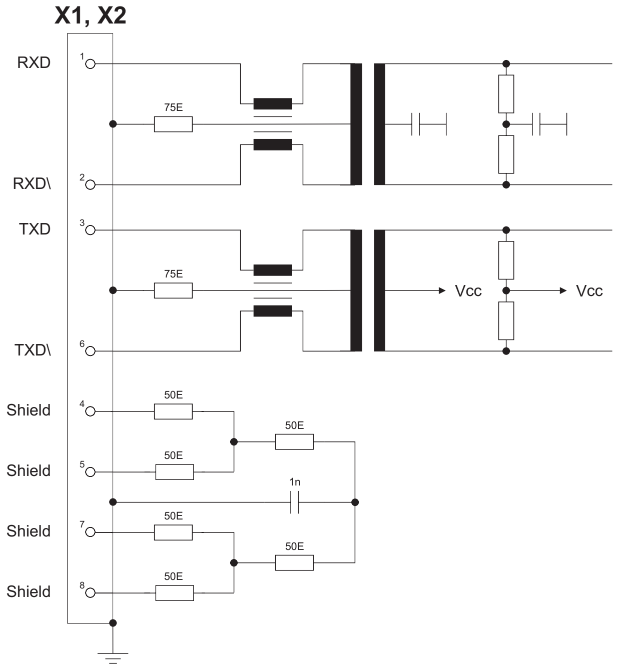

X1, X2
RXD
1
75E
RXD\
2
TXD
3
75E
Vcc
Vcc
TXD\
6
Shield
4
50E
50E
Shield
5
50E
1n
Shield
7
50E
50E
Shield
8
50E

Figure 49: Input/Output Circuit Diagram AC112

6.3 AC120 - EnDat Encoder Interface

6.3.1 Pin Assignments

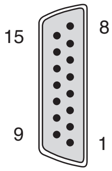
Image	X1	Pin	Description	Function in EnDat mode	Function in Incremental mode
		1	A	Channel A	
		2	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V	
		3	B	Channel B	
		4	+5V out / 0.25A	Encoder supply +5 V	
		5	D	Data input	---
		6	---	---	
		7	R\	---	Reference Pulse Inverted
		8	T	Clock output	---
		9	A\	Channel A inverted	
		10	Sense COM	Sense input 0 V	
		11	B\	Channel B inverted	
		12	Sense +5V	Sense input +5 V	
		13	D\	Data Inverted	---
		14	R	---	Reference Pulse
		15	T\	Clock output Inverted	---

Table 112: Pin assignments for AC120 - EnDat Encoder Interface

6.3.2 Input/Output Circuit Diagram

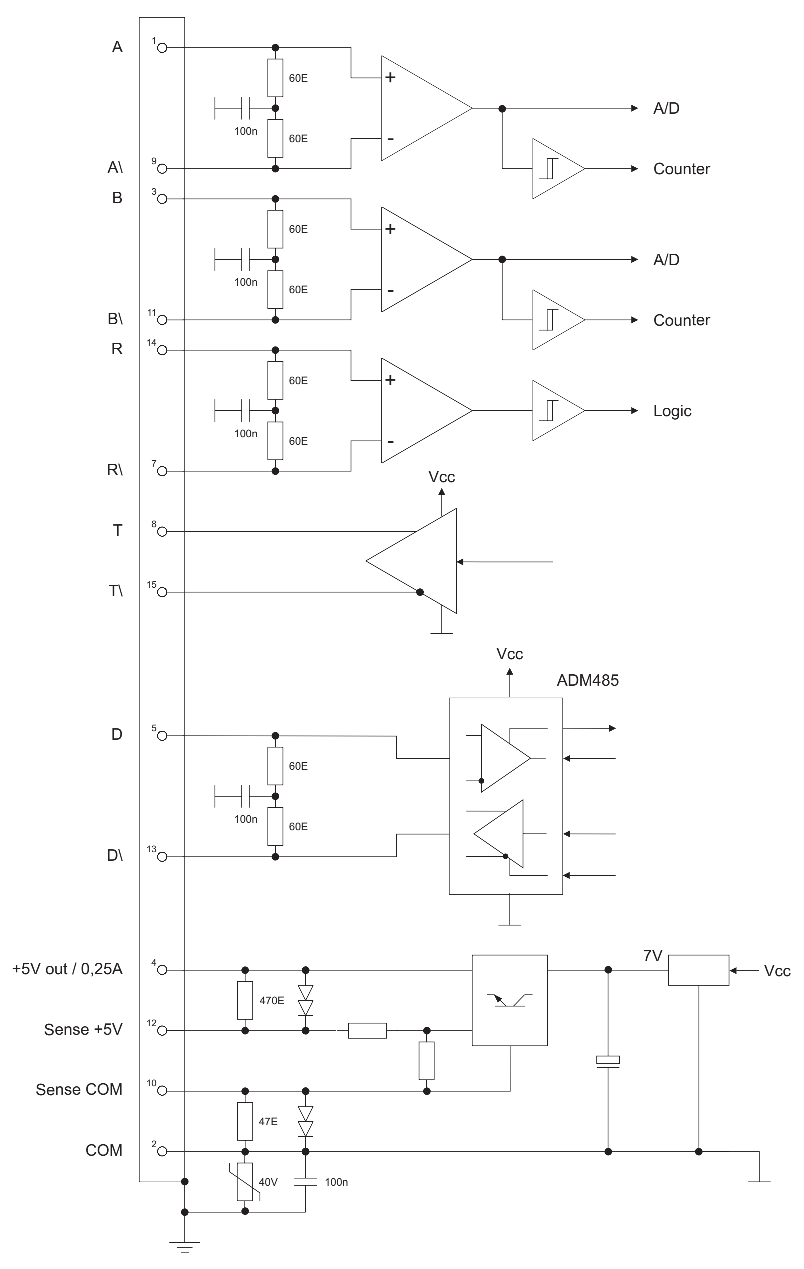

A
1
A\
9
B
3
B\
11
R
14
R\
7
T
8
T\
15
D
5
D\
13
+5V out / 0,25A
4
Sense +5V
12
Sense COM
10
COM
2
60E
100n
470E
47E
40V
Vcc
ADM485
7V
A/D
Counter
Logic
+
-

Figure 50: Input/Output Circuit Diagram AC120

6.4 AC122 - Resolver Interface

6.4.1 Pin Assignments

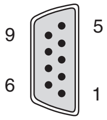
Image	X1	Pin	Description	Function
		1	---	---
		2	---	---
		3	Cos	Cosine input
		4	Sin	Sine input
		5	Ref	Reference output
		6	---	---
		7	Cos\	Cosine input inverted
		8	Sin\	Sine input inverted
		9	Ref \	Reference output inverted

Table 113: Pin assignments for AC122 - Resolver Interface

6.4.2 Input/Output Circuit Diagram

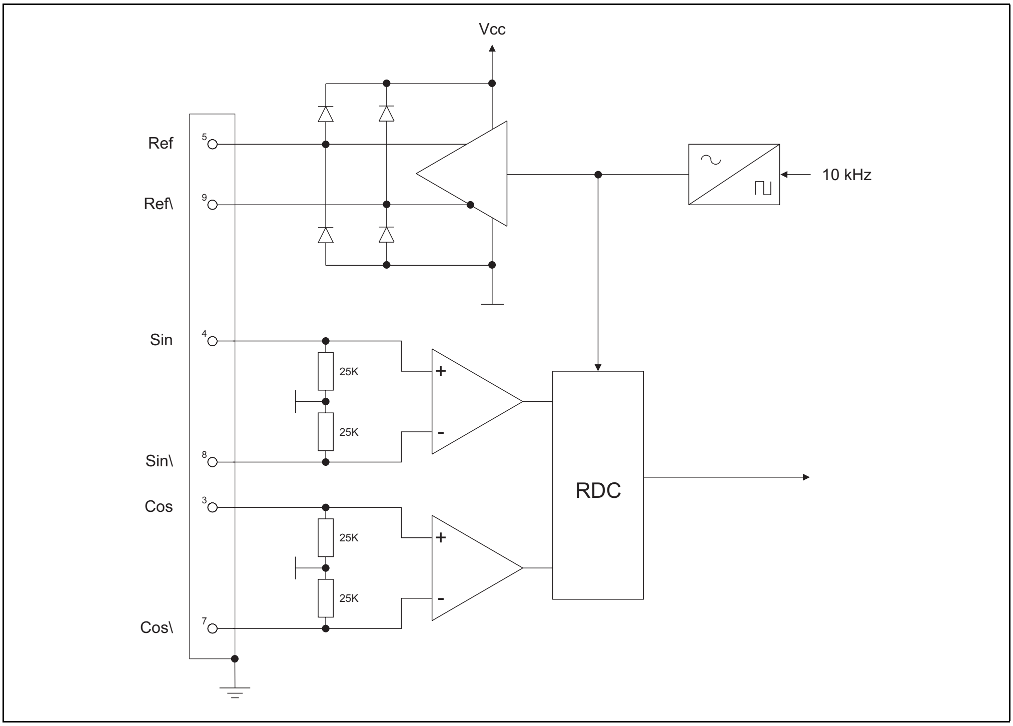

Vcc
Ref
5
Ref\
9
10 kHz
Sin
4
25K
25K
Sin\
8
Cos
3
25K
25K
Cos\
7
+
-
+
-
RDC

Figure 51: Input/Output Circuit Diagram AC122

6.5 AC123 - Incremental Encoder and SSI Absolute Encoder Interface

6.5.1 Pin Assignments

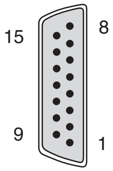
Image	X1	Pin	Description	Function in Incremental mode	Function in SSI mode
		1	A	Channel A	---
		2	A\	Channel A inverted	---
		3	B	Channel B	---
		4	B\	Channel B inverted	---
		5	RD	Reference Pulse	Data input
		6	RD\	Reference Pulse Inverted	Data input Inverted
		7	T	---	Clock output
		8	T\	---	Clock output Inverted
		9	+5V out / 0.35A	Encoder supply +5 V	
		10	Sense +5V	Sense +5 V	
		11	Sense COM	Sense 0 V	
		12	COM (7 - 9, 13)	Encoder supply 0 V	
		13	+15V out / 0.35A	Encoder supply +15 V	
		14	A1	Activate encoder supply 1)	
		15	A2	Activate encoder supply 1)	

Table 114: Pin assignments AC123 - incremental encoder and SSI absolute encoder interface

1) To activate the encoder supply, pins 14 and 15 must be connected in the encoder cable plug.

6.5.2 Input/Output Circuit Diagram

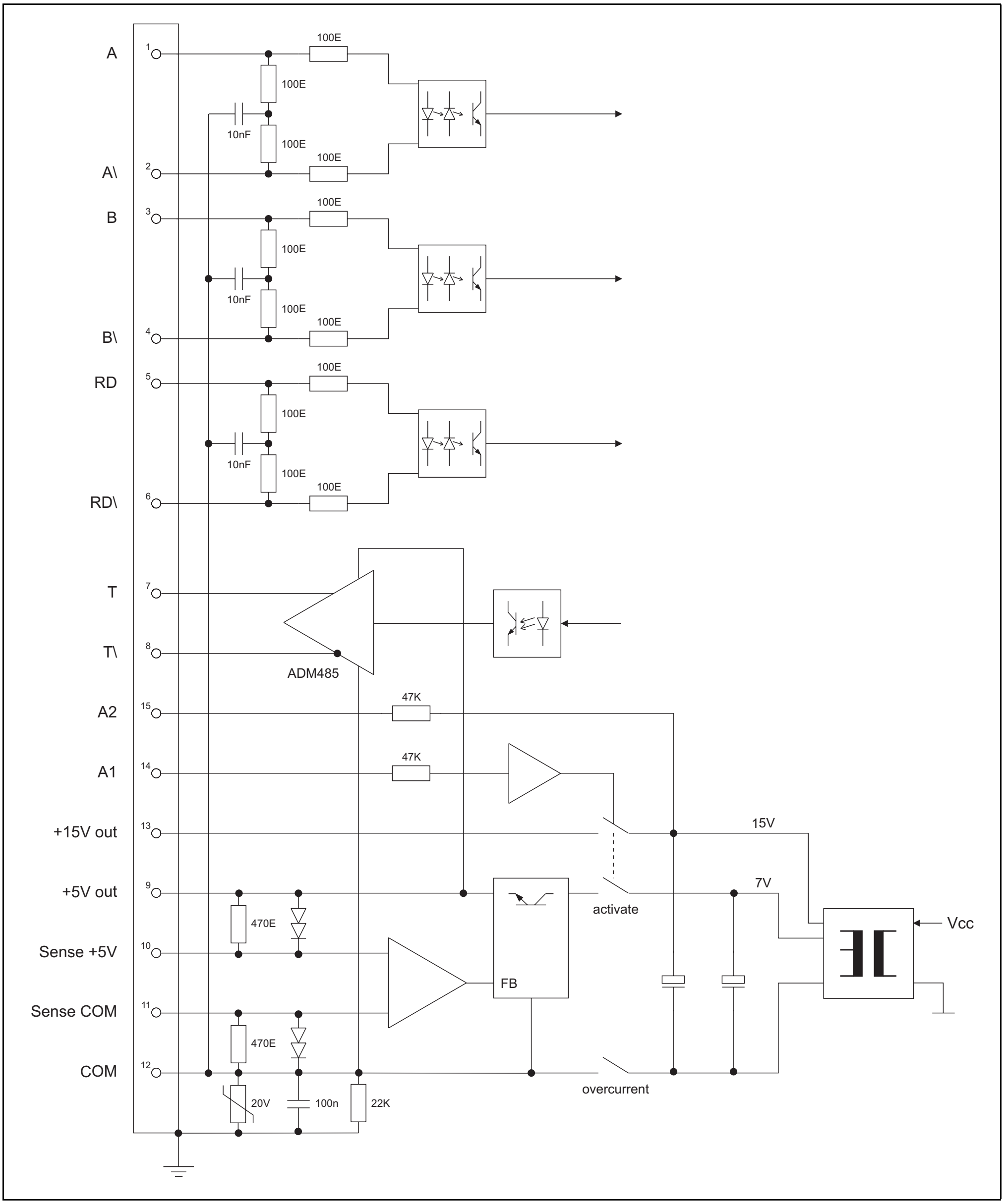
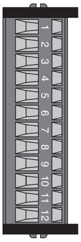

A
1
A\
2
B
3
B\
4
RD
5
RD\
6
T
7
T\
8
A2
15
A1
14
+15V out
13
+5V out
9
Sense +5V
10
Sense COM
11
COM
12
100E
10nF
ADM485
47K
470E
20V
100n
22K
FB
activate
overcurrent
15V
7V
Vcc

Figure 52: Input/Output Circuit Diagram AC123

6.6 AC130 - Digital Mixed Module

6.6.1 Pin Assignments

Image	X1	Pin	Description	Function
		1	Digital I/O 1	Digital input / output 1
		2	Digital I/O 2	Digital input / output 2
		3	Digital I/O 3	Digital input / output 3
		4	Digital I/O 4	Digital input / output 4
		5	Digital I/O 5	Digital input / output 5
		6	Digital I/O 6	Digital input / output 6
		7	Digital I/O 7	Digital input / output 7
		8	Digital I/O 8	Digital input / output 8
		9	Digital O 9	Digital output 9
		10	Digital O 10	Digital output 10
		11	+24V	Supply +24 V
		12	COM (1-11)	Supply 0 V

Terminal Cross Sections	[mm²]	[AWG]
Solid core / multiple conductor lines	0.5 - 1.5	20 - 14
Flexible, multiple wire line without Wire Tip Sleeves with Wire Tip Sleeves	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14
Approbation data (UL/C-UL-US- and CSA) UL/C-UL-US CSA	 --- ---	 26 - 14 26 - 14
Holding torque for the terminal screws [Nm]	0.2 ... 0.25	

Table 115: Pin assignments AC130 - digital mixed module

6.6.2 Input/Output Circuit Diagram

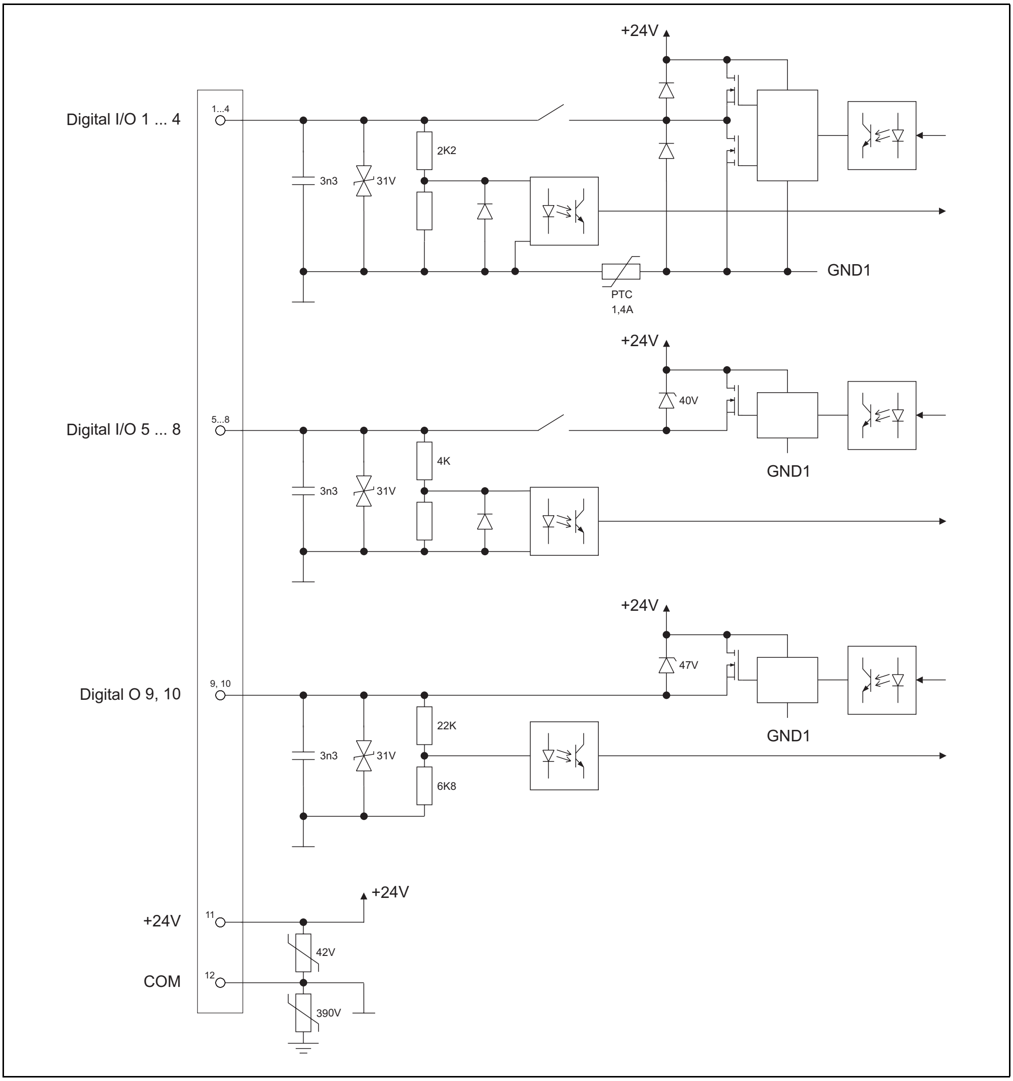
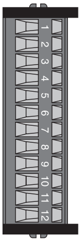

+24V
Digital I/O 1 ... 4
1...4
2K2
3n3
31V
GND1
PTC
1,4A
+24V
40V
Digital I/O 5 ... 8
5...8
4K
3n3
31V
GND1
+24V
47V
Digital O 9, 10
9, 10
22K
3n3
31V
6K8
GND1
+24V
+24V
11
42V
COM
12
390V

Figure 53: Input/Output Circuit Diagram AC130

6.7 AC131 - Mixed Module

6.7.1 Pin Assignments

Image	X1	Pin	Description	Function
		1	Analog I 1 +	Analog input 1 plus
		2	Analog I 1 -	Analog input 1 minus
		3	COM (1, 2, 5, 6)	Analog input 0 V
		4	Shield	Shielding
		5	Analog I 2 +	Analog input 2 plus
		6	Analog I 2 -	Analog input 2 minus
		7	COM (1, 2, 5, 6)	Analog input 0 V
		8	Shield	Shielding
		9	Digital I/O 1	Digital input / output 1
		10	Digital I/O 2	Digital input / output 2
		11	+24V	Supply +24 V
		12	COM (9-11)	Supply 0 V

Terminal Cross Sections	[mm²]	[AWG]
Solid core / multiple conductor lines	0.5 - 1.5	20 - 14
Flexible, multiple wire line without Wire Tip Sleeves with Wire Tip Sleeves	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14
Approbation data (UL/C-UL-US- and CSA) UL/C-UL-US CSA	 --- ---	 26 - 14 26 - 14
Holding torque for the terminal screws [Nm]	0.2 ... 0.25	

Table 116: Pin assignments AC131 - digital mixed module

6.7.2 Input/Output Circuit Diagram

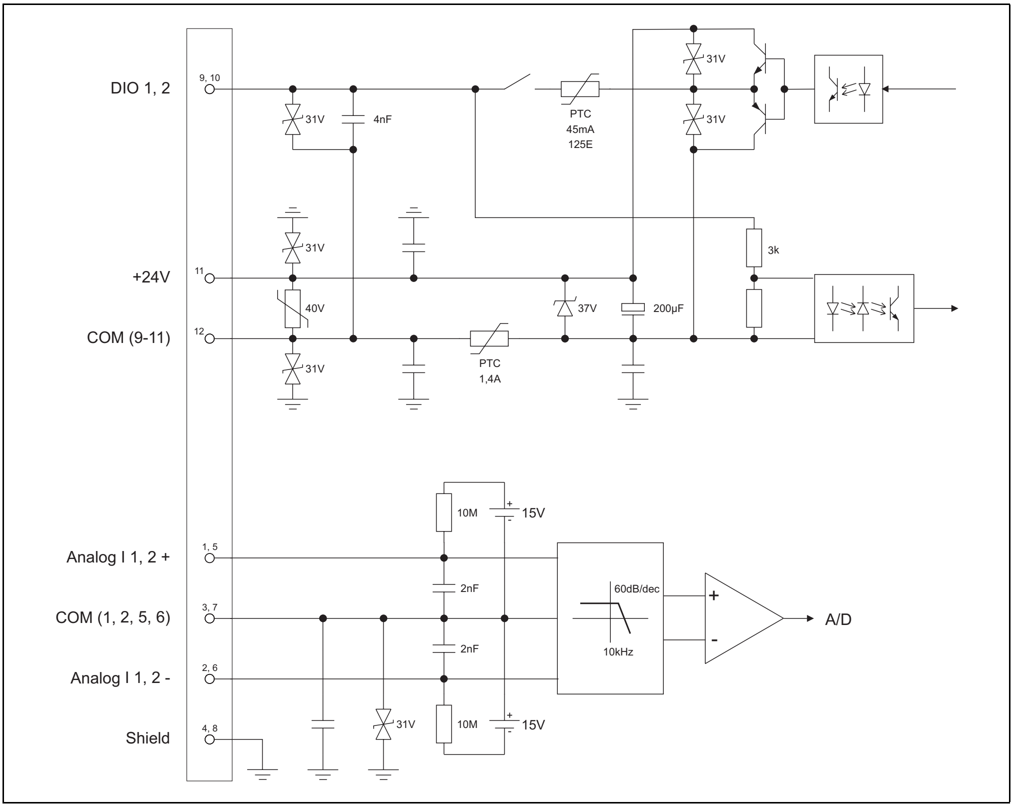
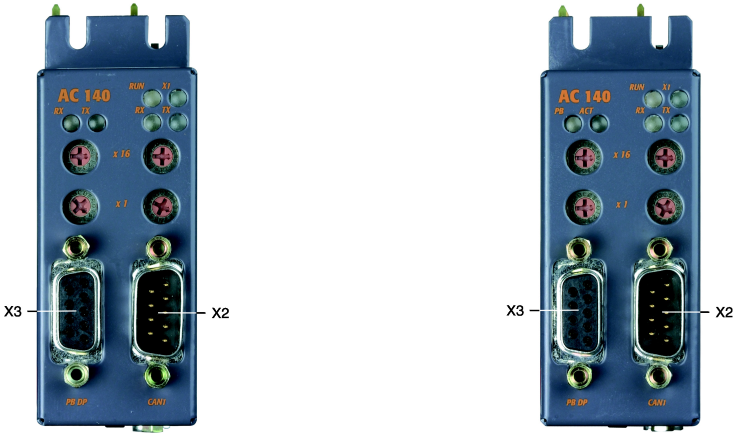

DIO 1, 2
9, 10
31V
4nF
PTC
45mA
125E
31V
31V
+24V
11
31V
3k
40V
37V
200µF
COM (9-11)
12
31V
PTC
1,4A
10M
15V
Analog I 1, 2 +
1, 5
2nF
60dB/dec
COM (1, 2, 5, 6)
3, 7
10kHz
A/D
2nF
Analog I 1, 2 -
2, 6
Shield
4, 8
31V
10M
15V

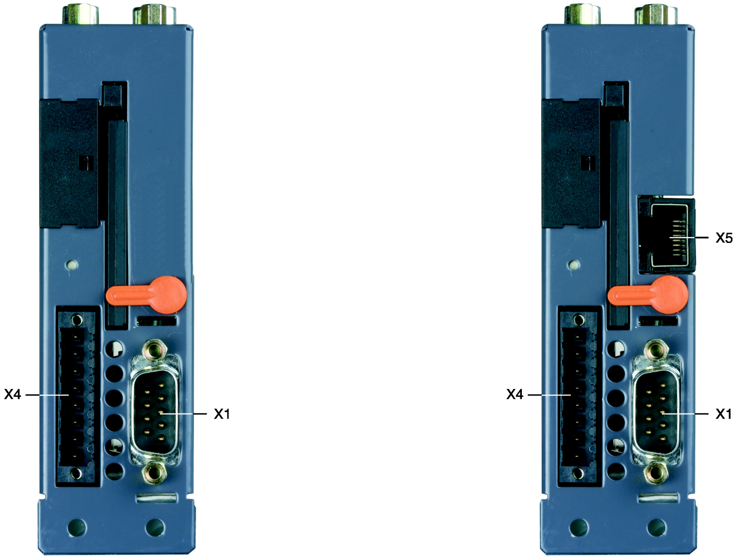
Figure 54: Input/Output Circuit Diagram AC131

6.8 AC140 - CPU Module



8AC140.60-1 8AC140.61-2

Figure 55: Overview of AC140 connections (view from front)



8AC140.60-1 8AC140.61-2

Figure 56: Overview of AC140 connections (view from below)

6.8.1 Application Interface IF1 (RS232)

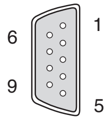
X1	Pin	Description	Function
	1	DCD	Data Carrier Detect
	2	RXD	Receive Signal
	3	TXD	Transmit Signal
	4	DTR	Data Terminal Ready
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
	9	RIN	Ring Indicator

Table 117: Pin assignments for X1 (RS232)

6.8.2 Application Interface IF2 (CAN)

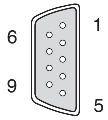
X2	Pin	Description	Function
	1	---	---
	2	CAN_L	CAN Low
	3	CAN_GND	CAN 0 V
	4	---	---
	5	---	---
	6	---	---
	7	CAN_H	CAN High
	8	---	---
	9	---	---

Table 118: Pin assignments for X2 (CAN)

6.8.3 Application Interface IF3 (Profibus)

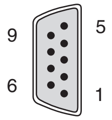
X3	Pin	Description	Function
	1	---	---
	2	---	---
	3	DATA	Data
	4	CNTRL	Transmit enable
	5	Profibus_GND	Profibus GND (electrically isolated)
	6	+5V / 50mA	+5 V supply / 50 mA (electrically isolated)
	7	---	---
	8	DATA\	Data\
	9	CNTRL\	Transmit Enable\

Table 119: Pin assignment for X3 (Profibus)

6.8.4 X4 Connector (inputs/outputs)

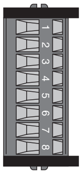
X4	Pin	Description	Function in Incremental counter Mode	Function in Period/gate measurement mode	Function in Stepper motor counter mode
	1	GND	GND		
	1	+24 VDC	+24V supply		
	3	Digital I/O 1	A	Counter Input	
	4	Digital I/O 2	B	---	Counting Direction
	5	Digital I/O 3	R	External Clock	
	6	Shield	Shielding		
	7	Analog I +	Analog Input +		
	8	Analog I -	Analog Input -		

Table 120: Pin assignments X4 (inputs/outputs)

6.8.5 Application Interface IF6 (Ethernet) [1]

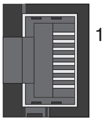
X3	Pin	Description	Function
	1	RXD	Receive Signal
	2	RXD\	Receive Signal Inverted
	3	TXD	Transmit Signal
	4	Termination	Termination
	5	Termination	Termination
	6	TXD\	Transmit Signal Inverted
	7	Termination	Termination
	8	Termination	Termination

Table 121: Pin assignments for X6 (Ethernet)

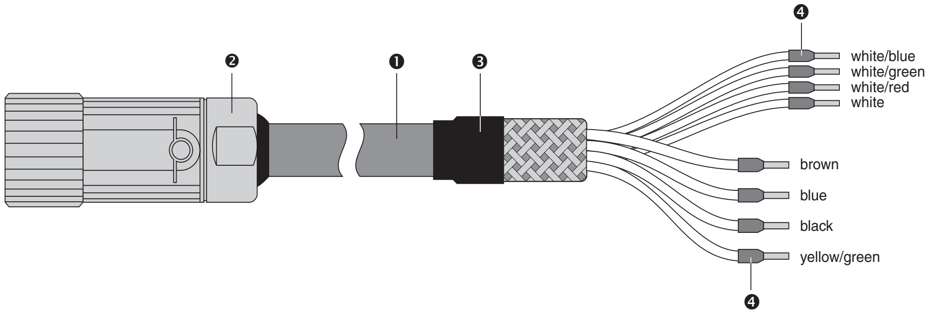
---

[1] This interface is only available for 8AC140.61-2.

7. Cables

7.1 Motor Cables

7.1.1 Motor Cable Construction


❹
❷
❶
❸
white/blue
white/green
white/red
white
brown
blue
black
yellow/green
❹

Pos.	Pieces	Description	Note
1	1	Motor lines	4 x 1.5 mm² + 2 x 2 x 0.75 mm² 4 x 4 mm² + 2 x 2 x 1 mm² 4 x 10 mm² + 2 x 2 x 1.5 mm² 4 x 35 mm² + 2 x 2 x 1.5 mm² (not prefabricated)
2	1	Circular connector	BSTA 108 FR 19 58 0036 000 (for 8CMxxx.12-1) BSTA 108 FR 35 59 0036 000 (for 8CMxxx.12-3) CSTA 264 FR 48 25 0001 000 (for 8CMxxx.12-5)
3	1	Heat shrink tubing	
4	8	Wire tip sleeve	

Table 122: Motor cable construction

7.1.2 Pin Assignments for 8CMxxx.12-1, 8CMxxx.12-3

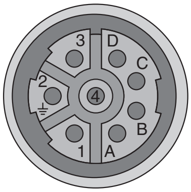
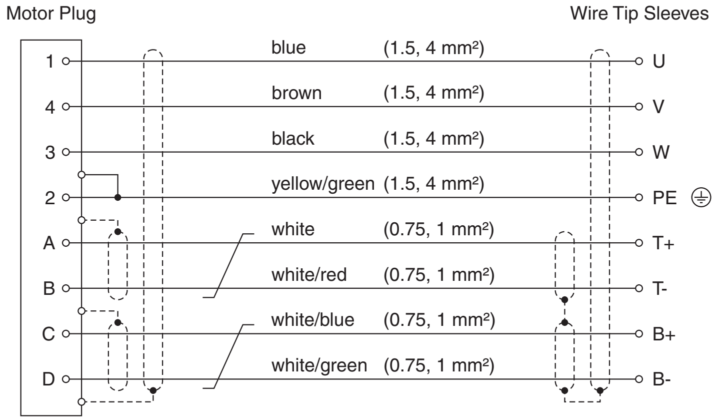
Circular connector	Pin	Description	Function
	1	U	Motor connection U
	4	V	Motor connection V
	3	W	Motor connection W
	2	PE	Protective ground conductor
	A	T+	Temperature +
	B	T-	Temperature -
	C	B+	Brake +
	D	B-	Brake -

Table 123: Pin assignments for motor cable 8CMxxx.12-1, 8CMxxx.12-3

7.1.3 Cable Schematic for 8CMxxx.12-1, 8CMxxx.12-3


Motor Plug
Wire Tip Sleeves
1
4
3
2
A
B
C
D
blue (1.5, 4 mm²)
brown (1.5, 4 mm²)
black (1.5, 4 mm²)
yellow/green (1.5, 4 mm²)
white (0.75, 1 mm²)
white/red (0.75, 1 mm²)
white/blue (0.75, 1 mm²)
white/green (0.75, 1 mm²)
U
V
W
PE
T+
T-
B+
B-

All shields connected to the plug

Figure 57: Cable schematic for motor cables 8CMxxx.12-1, 8CMxxx.12-3

7.1.4 Pin Assignments for 8CMxxx.12-5

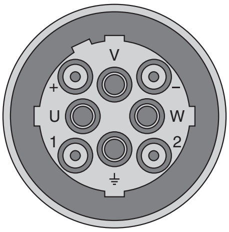
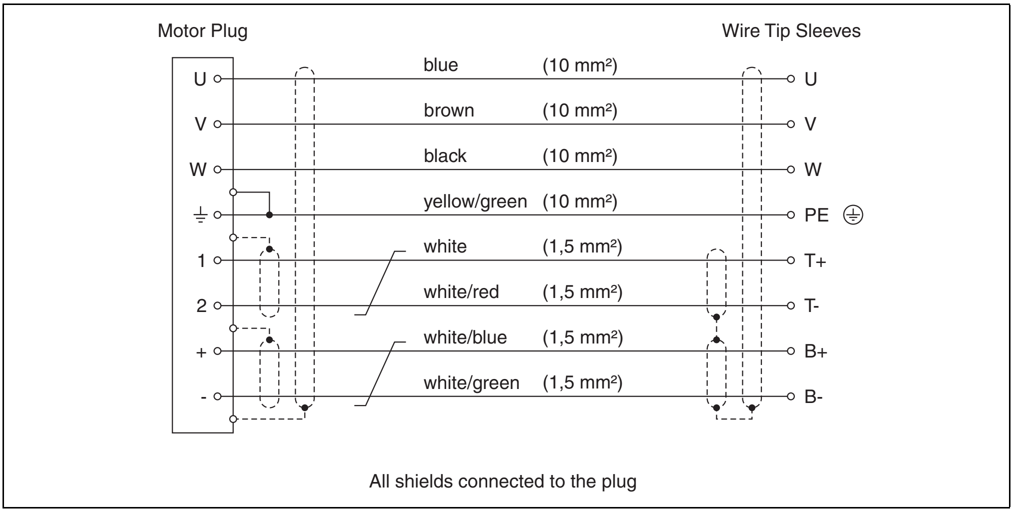
Circular connector	Pin	Description	Function
	U	U	Motor connection U
	V	V	Motor connection V
	W	W	Motor connection W
	⏚	PE	Protective ground conductor
	1	T+	Temperature +
	2	T-	Temperature -
	+	B+	Brake +
	-	B-	Brake -

Table 124: Pin assignments for motor cables 8CMxxx.12-5

7.1.5 Cable Schematic for 8CMxxx.12-5

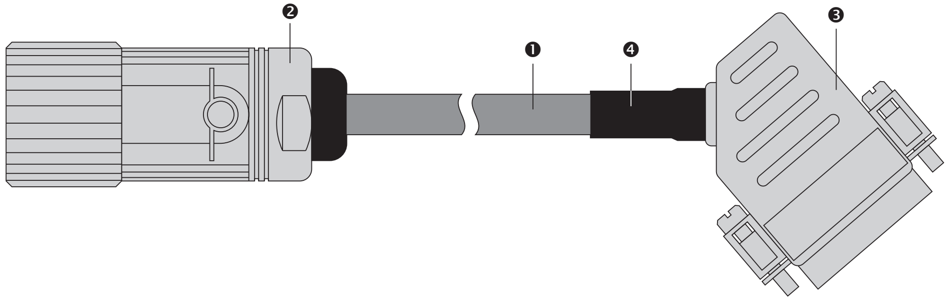

Motor Plug
Wire Tip Sleeves
U
V
W
⏚
1
2
+
-
blue (10 mm²)
brown (10 mm²)
black (10 mm²)
yellow/green (10 mm²)
white (1,5 mm²)
white/red (1,5 mm²)
white/blue (1,5 mm²)
white/green (1,5 mm²)
U
V
W
PE ⏚
T+
T-
B+
B-

All shields connected to the plug

Figure 58: Cable schematic for motor cables 8CMxxx.12-5

7.2 EnDat Encoder Cables

7.2.1 EnDat Encoder Cable Construction



Pos.	Pieces	Description	Note
1	1	Encoder cable	10 x 0.14 mm^2 + 2 x 0.50 mm^2
2	1	Circular connector, 17 pin socket	ASTA 035 FR 11 12 0035 000
3	1	DSUB housing 45°, metal plated, 15-pin plug	
4	1	Heat shrink tubing	

Table 125: EnDat encoder cable construction

7.2.2 Pin Assignments

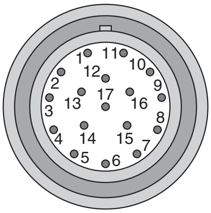
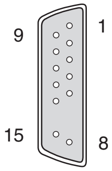
Circular connector	Pin	Description	Function	Pin	DSUB plug
 1 11 10 12 2 9 17 13 16 3 8 4 14 15 7 5 6	15	A	Channel A	1	
	10	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V	2	
	12	B	Channel B	3	
	7	+5V out / 0.25A	Encoder supply +5 V	4	
	14	D	Data input	5	
	8	T	Clock output	8	
	16	A\	Channel A inverted	9	
	4	Sense COM	Sense input 0 V	10	
	13	B\	Channel B inverted	11	
	1	Sense +5V	Sense input +5 V	12	
	17	D\	Data inverted	13	
	9	T\	Clock output inverted	15	

Table 126: Pin assignments for EnDat encoder cables

7.2.3 Cable Schematic

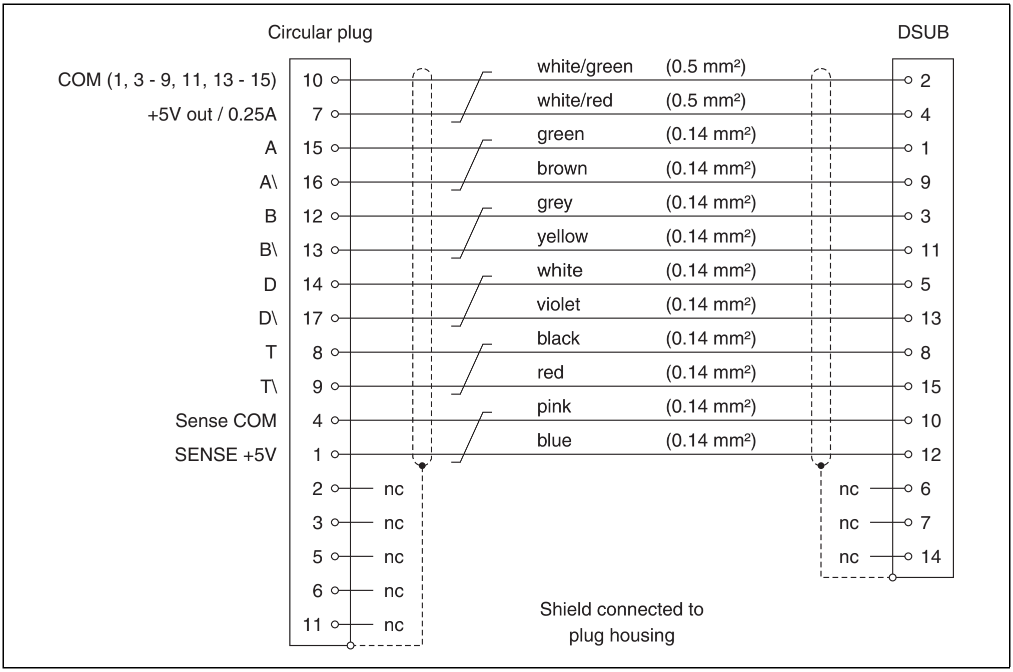
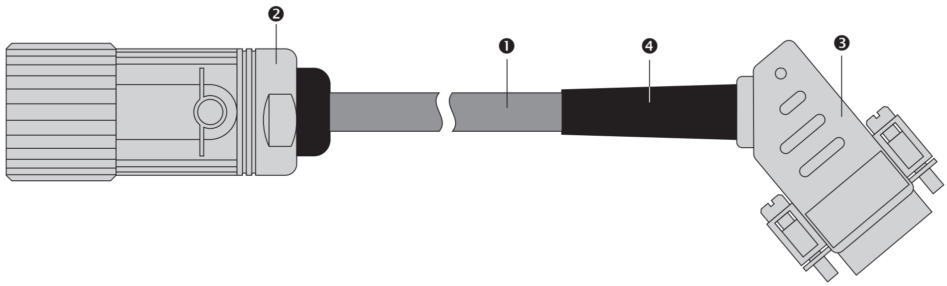

Circular plug
DSUB
COM (1, 3 - 9, 11, 13 - 15)
+5V out / 0.25A
A
A\
B
B\
D
D\
T
T\
Sense COM
SENSE +5V
10
7
15
16
12
13
14
17
8
9
4
1
2
3
5
6
11
nc
white/green (0.5 mm²)
white/red (0.5 mm²)
green (0.14 mm²)
brown (0.14 mm²)
grey (0.14 mm²)
yellow (0.14 mm²)
white (0.14 mm²)
violet (0.14 mm²)
black (0.14 mm²)
red (0.14 mm²)
pink (0.14 mm²)
blue (0.14 mm²)
2
4
1
9
3
11
5
13
8
15
10
12
6
7
14
Shield connected to plug housing

Figure 59: Cable schematic for EnDat encoder cables

7.3 Resolver Cables

7.3.1 Resolver Cable Construction



Pos.	Pieces	Description	Note
1	1	Encoder cable	3 x 2 x 24 AWG/19
2	1	Circular connector, 12 pin socket	ASTA 021 FR 11 10 0035 000
3	1	DSUB housing 45°, metal plated, 9 pin plug	
4	1	Kink protection	

Table 127: Resolver cable construction

7.3.2 Pin Assignments

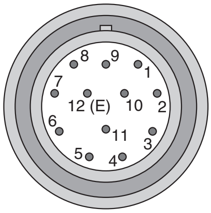
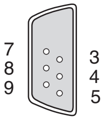
Circular connector	Pin	Description	Function	Pin	DSUB plug
	1	---			
	2	---			
	3	Cos	Cosine input	3	
	4	Sin	Sine input	4	
	5	Ref	Reference output	5	
	6	---			
	7	Cos\	Cosine input inverted	7	
	8	Sin\	Sine input inverted	8	
	9	Ref \	Reference output inverted	9	
	10	---			
	11	---			
	12	---			

Table 128: Pin assignments for resolver cable

7.3.3 Cable Schematic

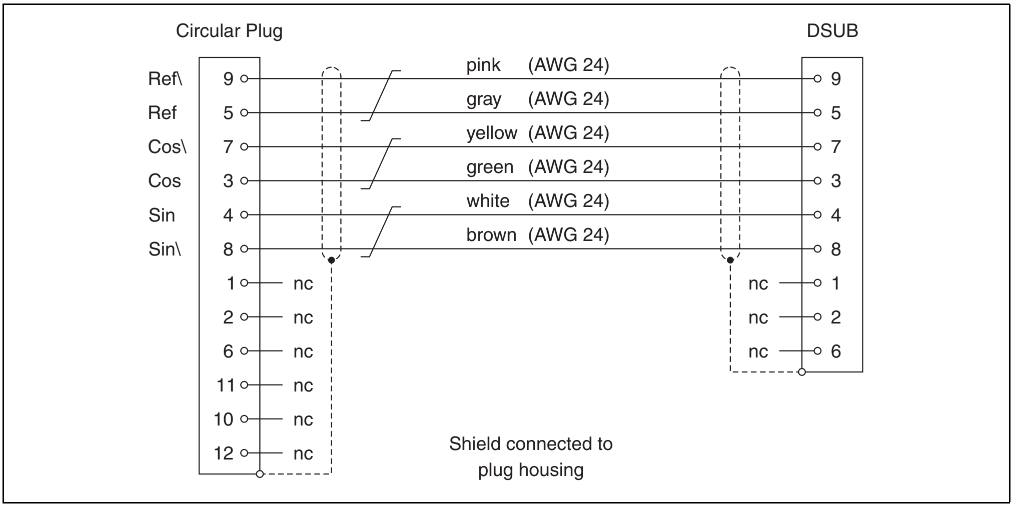

Circular Plug
DSUB
Ref\
Ref
Cos\
Cos
Sin
Sin\
9
5
7
3
4
8
1
2
6
11
10
12
nc
pink (AWG 24)
gray (AWG 24)
yellow (AWG 24)
green (AWG 24)
white (AWG 24)
brown (AWG 24)
Shield connected to plug housing

Figure 60: Cable schematic for resolver cables

Chapter 6 • Getting Started

1. Preparation

1.1 Unpacking the ACOPOS Servo Drive

Remove the protective packaging from the ACOPOS servo drive. Check the ACOPOS servo drive for obvious mechanical damage.

> ## Danger!
>
> **Do not operate the ACOPOS servo drive if it is damaged. This can cause severe personal injury or damage to property!**

1.2 Installing and Connecting the ACOPOS Servo Drive

The guidelines and specifications for installing and wiring the respective ACOPOS servo drive can be found in chapter 3 "Installation", chapter 4 "Dimensioning" and chapter 5 "Wiring".

1.3 Connecting the ACOPOS Servo Drive with a B&R PLC

Depending on the configuration, ACOPOS servo drives are equipped with a CAN (AC110) or ETHERNET Powerlink (AC112) interface which can be used to connect to a B&R PLC. The connection is made using a a CAN cable (AC110) or an Ethernet cable 1) (AC112) (pin assignments can be found in chapter 5 "Wiring" and in the User's Manual for the PLC).

---

1) Caution: In general, crossover Ethernet cables must be used for ETHERNET Powerlink connections!

2. Starting Up an ACOPOS Servo Drive

The goal of the following example is move the shaft of a motor connected to an ACOPOS servo drive 5000 units. In order to emphasize the important points of starting up the hardware, this will be done using an sample project contained in B&R Automation Studio™.

> **Danger!**
>
> **Incorrect control of motors or mechanical parts connected to the motor shaft can cause unwanted and dangerous movements!**

2.1 General Information

The start-up procedure described here is based on the following configuration: [1]

Model Number	Short Description
	Servo Drives
8V1045.00-1	Servo drive 3 x 400-480V 4.4A 2kW, line filter and braking resistor integrated
	Plug-in modules
8AC110.60-1	ACOPOS plug-in module, CAN interface
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface
	Motor
8MSA4L.E0-B4	Motor MSA4 series with EnDat encoder
	Accessories
7AC911.9	Bus connector, CAN (2 pcs.)
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm² + 2 x 0.5mm², EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed
8CM005.12-1	Motor cable, length 5m, 4 x 1,5mm² + 2 x 2 x 0,75mm², motor connector 8 pin Intercontec socket, can be used in cable drag chains, UL/CSA listed
0G0001.00-090	Cable PC <--> PLC/PW, RS232, Online cable
	PLC CPU
7CP476.60-1	2003 CPU, 750 KB SRAM, 1.5 MB FlashPROM, 24 VDC, 12.5 W supply, 1 RS232 interface, 1 CAN interface, CAN: electrically isolated, network capable, 4 slots for screw-in modules, system bus for expansion modules, max. 272 digital / 80 analog I/O points
	B&R Automation Studio™
1A4000.Lx	B&R AutomationSoftware™ CD, full version

Table 129: Configuration for the start-up example

The hardware configuration will be called the "target system" in the following sections. A PC with B&R Automation Studio™ installed will also be needed.

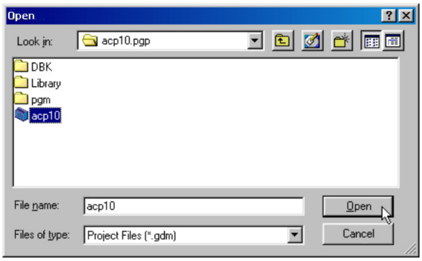
---

[1] The procedure can change slightly depending on the hardware configuration. The procedure does **not** change using an 8V1045.00-2.

2.1.1 Sample project

Several sample projects are available in B&R Automation Studio™ which can be used to test ACOPOS servo drives.
They are found in the directory "...\BR_AS_xxx_yyyy\SAMPLES\MOTION" in the B&R Automation Studio™ installation directory. 1)

Starting with ACOPOS operating system version V 0.472, this start-up example is based on the sample project:
"...\BR_AS_xxx_yyyy\SAMPLES\MOTION\ENGLISH\ACP10\CAN\M68K\C\ACP10.PGP\ACP10.GDM". 1)



Look in: acp10.pgp

File name: acp10

Files of type: Project Files (*.gdm)

Figure 61: Open sample project

Information:

During start-up, changes will be made to the sample project. We recommend that you make a copy of the sample project (entire ACP10.PGP directory, see figure 61 "Open sample project") in a different project directory and use it for the start-up.

2.1.2 Preparing the Hardware for Sample Project acp10.gdm

- Check the wiring of the ACOPOS servo drive connections
  (also see Chapter 5 "Wiring").
- Set node number 1 on the AC110 plug-in module
  (see chapter 2 "Technical Data").
- Connect the PC to the PLC using the online cable.
  (see PLC user's manual for information about connecting the online cable to the PLC).
- Apply power to the PLC and the ACOPOS servo drive (24 VDC, 400 VAC). You can make sure the ACOPOS servo drive boots correctly by watching the blink code (see chapter 2 "Technical Data").

---

1) xxx refers to the B&R Automation Studio™ version number; yyyy refers to the language version, e.g. L049 for German

2.2 Commissioning

2.2.1 Load Sample Project

Start B&R Automation Studio™:

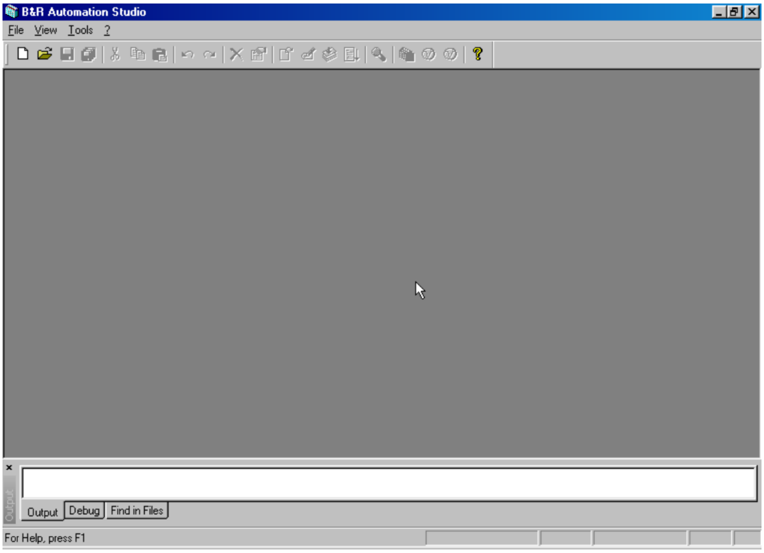
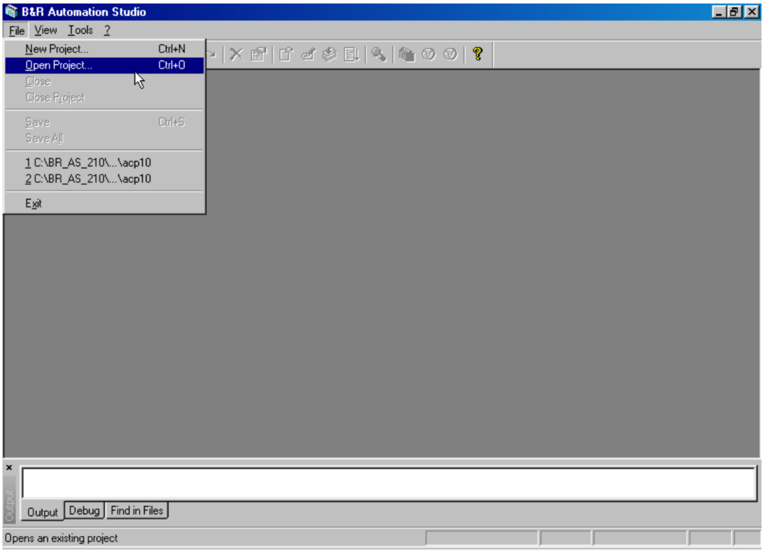

B&R Automation Studio
File View Tools ?
Output
Output Debug Find in Files
For Help, press F1

Figure 62: B&R Automation Studio™ Start-up Screen

Open the project (recommended: make a copy of sample project ACP10.GDM in the respective project path):

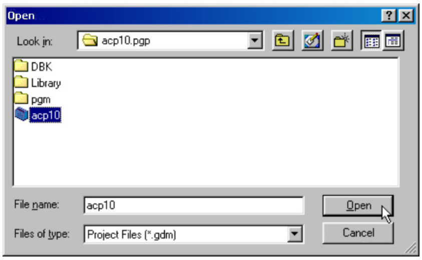
- Click **Open Project ...** in the **File** menu.


B&R Automation Studio
File
View
Tools
?
New Project... Ctrl+N
Open Project... Ctrl+O
Close
Close Project
Save Ctrl+S
Save All
1 C:\BR_AS_210\...\acp10
2 C:\BR_AS_210\...\acp10
Exit
Output
Debug
Find in Files

Opens an existing project

Figure 63: Open the project

- Select ...\ACP10.PGP\ACP10.GDM.
- Load the project by clicking on the **Open** button.


Open
DBK
Library
pgm
acp10
Open
Cancel

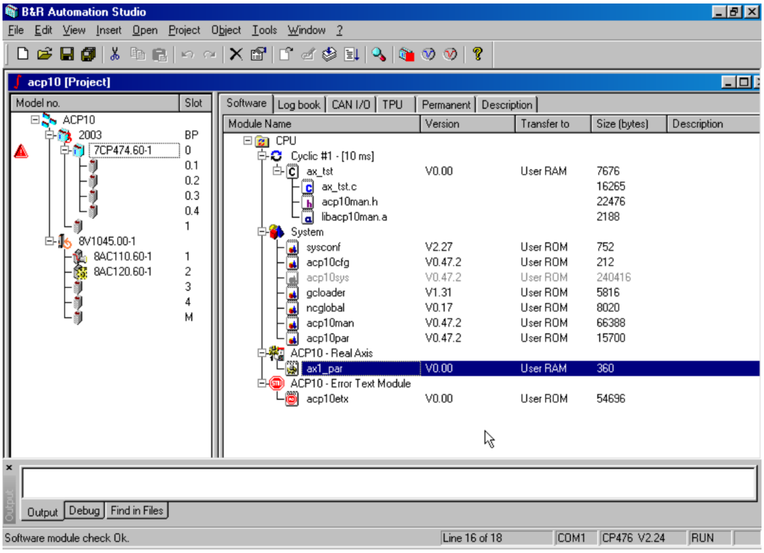
Look in: acp10.pgp

File name: acp10

Files of type: Project Files (*.gdm)

Figure 64: Select the project

The selected project is then opened in the project window:


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files

Model no.	Slot
ACP10	
2003	BP
7CP474.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Software module check Ok. | Line 16 of 18 | COM1 | CP476 V2.24 | RUN

Figure 65: Project window with representation of the hardware and software configuration

The left part of the window contains the hardware configuration for the project and the right part of the window contains the software configuration for the hardware component selected in the left part of the window.

Information:

When loading the project, a connection is automatically established between the PC and the PLC.

If the connection is active, the CPU type and "RUN" are shown to the right below the status bar (see figure 65 "Project window with representation of the hardware and software configuration").

2.2.2 Preset Values for the Sample Project

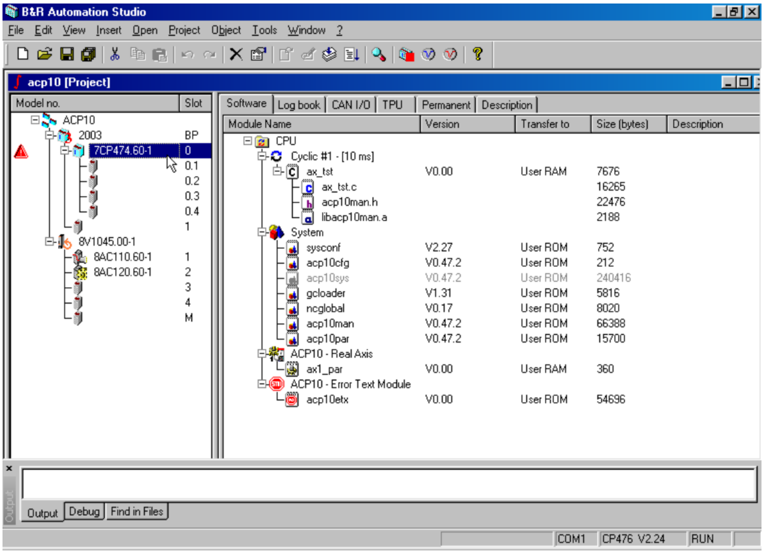
A few preset values must be defined on the target system before downloading the project.

CPU

The sample project was originally created for a different PLC CPU (7CP474.60-1).

This must be changed to the CPU used on the target system (shown to the right under the status bar):

- In the left part of the window, position the mouse pointer on the CPU (7CP474.60-1).

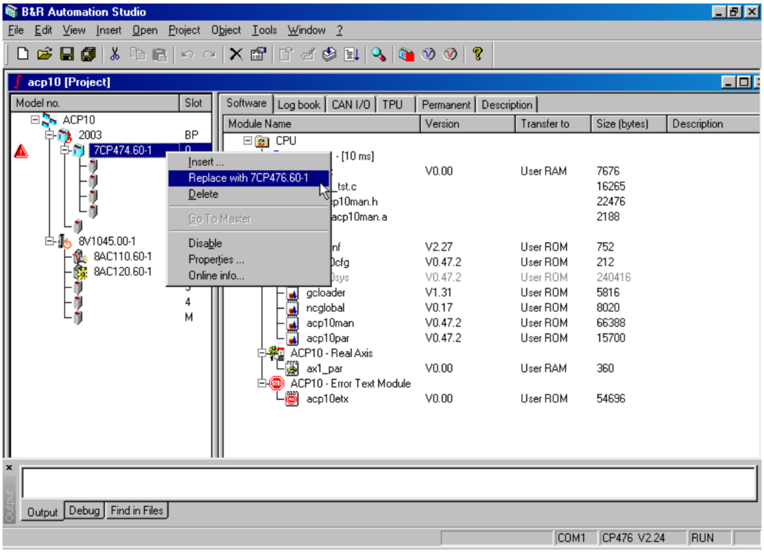

B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

Model no.	Slot
ACP10	
2003	BP
7CP474.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Figure 66: Select the CPU in the left part of the window

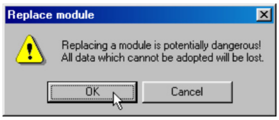
- Open the shortcut menu with the right mouse button.
- Position the mouse pointer on **Replace with 7CP476.60-1**.
- Select this menu item with the left mouse button.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Model no. Slot
ACP10
2003 BP
7CP474.60-1 0
8V1045.00-1
8AC110.60-1
8AC120.60-1
4
M
Insert ...
Replace with 7CP476.60-1
Delete
Go To Master
Disable
Properties ...
Online info...
Software Log book CAN I/O TPU Permanent Description
Output Debug Find in Files
COM1 CP476 V2.24 RUN

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
- [10 ms]				
	V0.00	User RAM	7676	
_tst.c			16265	
p10man.h			22476	
acp10man.a			2188	
nf	V2.27	User ROM	752	
0cfg	V0.47.2	User ROM	212	
0sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Figure 67: Select the command used to replace the CPU from the shortcut menu

- Acknowledge the change of the CPU by clicking on the **OK** button.


Replace module
OK
Cancel

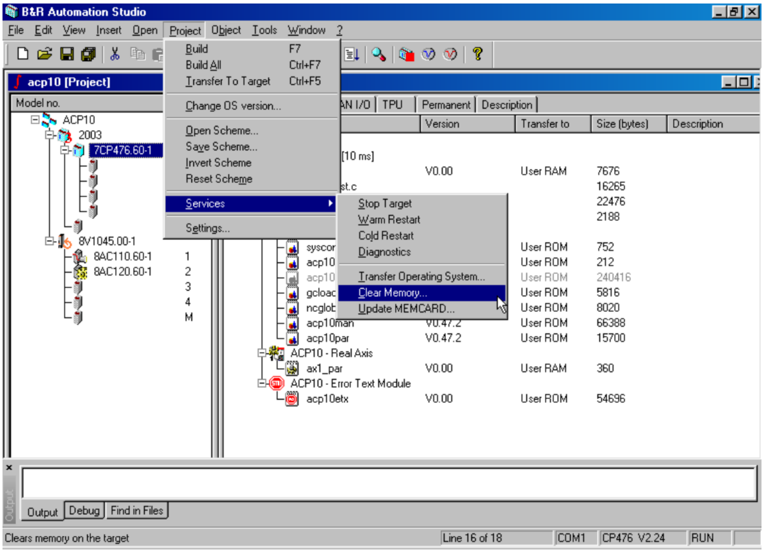
Replacing a module is potentially dangerous!
All data which cannot be adopted will be lost.

Figure 68: Acknowledge the change of the CPU

User Memory

Before downloading the sample project, we recommend clearing the user memory on the PLC:

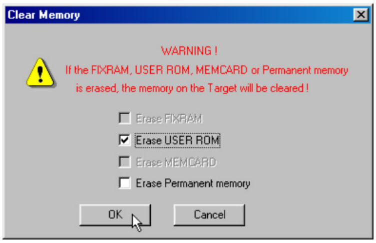
- In the **Project** menu, select **Services** and then **Clear Memory ...**.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
Build F7
Build All Ctrl+F7
Transfer To Target Ctrl+F5
Change OS version...
Open Scheme...
Save Scheme...
Invert Scheme
Reset Scheme
Services
Settings...
Stop Target
Warm Restart
Cold Restart
Diagnostics
Transfer Operating System...
Clear Memory...
Update MEMCARD...
acp10 [Project]
Output
Debug
Find in Files

Clears memory on the target | Line 16 of 18 | COM1 | CP476 V2.24 | RUN

Figure 69: Clearing user memory on the PLC

- Activate the checkbox **Erase USER ROM**.
- Acknowledge the selection by clicking the **OK** button.


Clear Memory

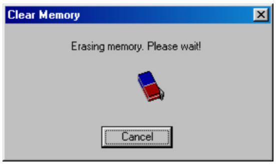
WARNING !
If the FIXRAM, USER ROM, MEMCARD or Permanent memory is erased, the memory on the Target will be cleared !

☐ Erase FIXRAM
☑ Erase USER ROM
☐ Erase MEMCARD
☐ Erase Permanent memory

OK
Cancel

Figure 70: Selecting the user memory on the PLC

- The user memory is erased.


Clear Memory
Cancel

Erasing memory. Please wait!

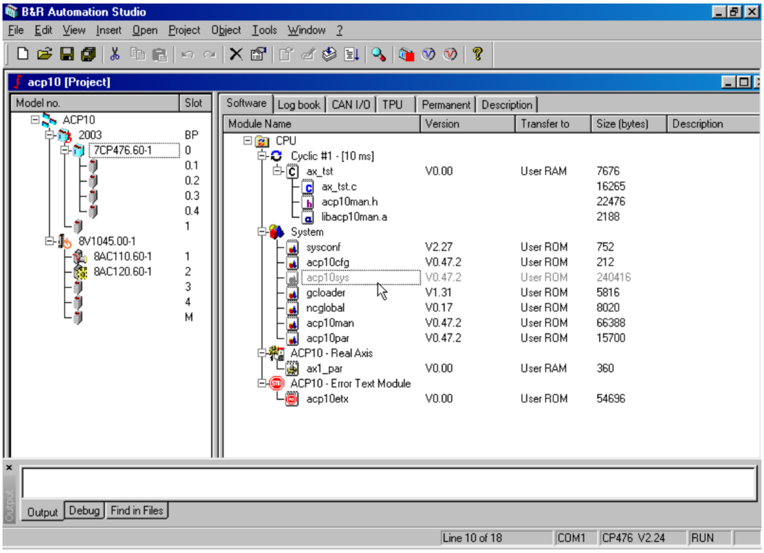
Figure 71: Clearing the user memory

After clearing the user memory, the project window will be shown again.

Downloading the Operating System

The first time an ACOPOS servo drive is started up, the ACOPOS operating system ACP10SYS must also be transferred to the target system. In the sample project, transferring ACP10SYS is deactivated (shown in gray in the right part of the window). Transferring ACP10SYS must be activated separately in the sample project:

- Position the mouse pointer on ACP10SYS in the right part of the window.

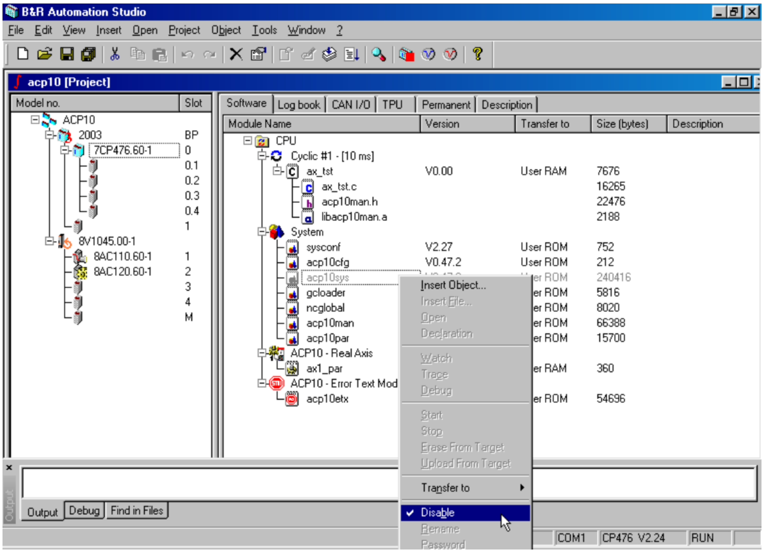

B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files
Line 10 of 18
COM1
CP476 V2.24
RUN

Model no.	Slot
ACP10	
2003	BP
7CP476.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Figure 72: Place mouse pointer on ACOPOS operating system ACP10SYS

- Open the shortcut menu with the right mouse button.
- Position the mouse pointer on **Disable**.
- Click on **Disable** with the left mouse button to cancel deactivation.

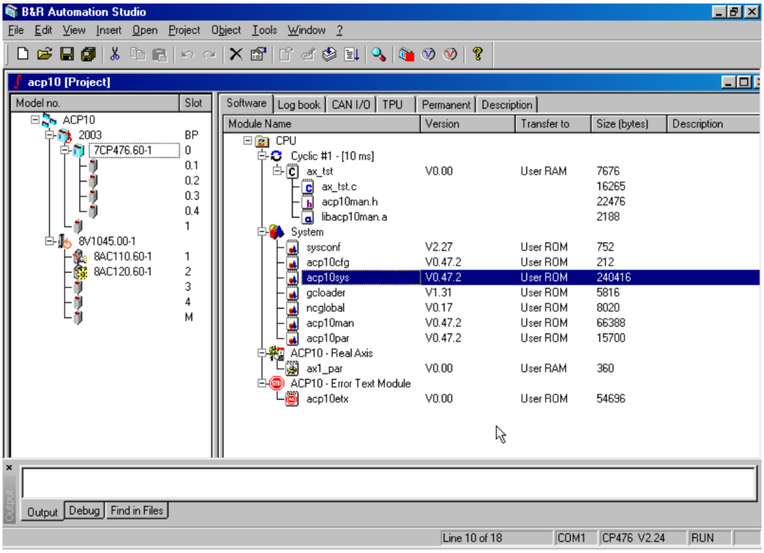

B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Insert Object...
Insert File...
Open
Declaration
Watch
Trace
Debug
Start
Stop
Erase From Target
Upload From Target
Transfer to
✓ Disable
Rename
Password
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

Model no.	Slot
ACP10	
2003	BP
7CP476.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys		er ROM	240416	
gcloader		er ROM	5816	
ncglobal		er ROM	8020	
acp10man		er ROM	66388	
acp10par		er ROM	15700	
ACP10 - Real Axis				
ax1_par		er RAM	360	
ACP10 - Error Text Mod				
acp10etx		er ROM	54696	

Figure 73: Enable transferring the ACOPOS operating system

ACP10SYS is now enabled (shown in black instead of gray) and is also transferred the next time the project is downloaded.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files
Line 10 of 18
COM1
CP476 V2.24
RUN

Model no.	Slot
ACP10	
2003	BP
7CP476.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Figure 74: The operating system is also transferred the next time the project is downloaded

Information:

After successfully downloading the operating system the first time, "Disable" can be set again which shortens the download time for projects.

2.2.3 Preset Values Concerning Wiring

The further procedure depends on the wiring of the digital control inputs on the ACOPOS servo drives.

End switch and Quickstop are wired

If the hardware end switches (normally closed) are wired to X1 / Limit+ and X1 / Limit- and a Quickstop switch (normally closed) is wired to X1 / Quickstop/Trigger2 according to section 3 "Pin Assignments ACOPOS 1022, 1045, 1090" on page 174, then start-up can be continued with section 2.2.4 "Downloading the Project" on page 236.

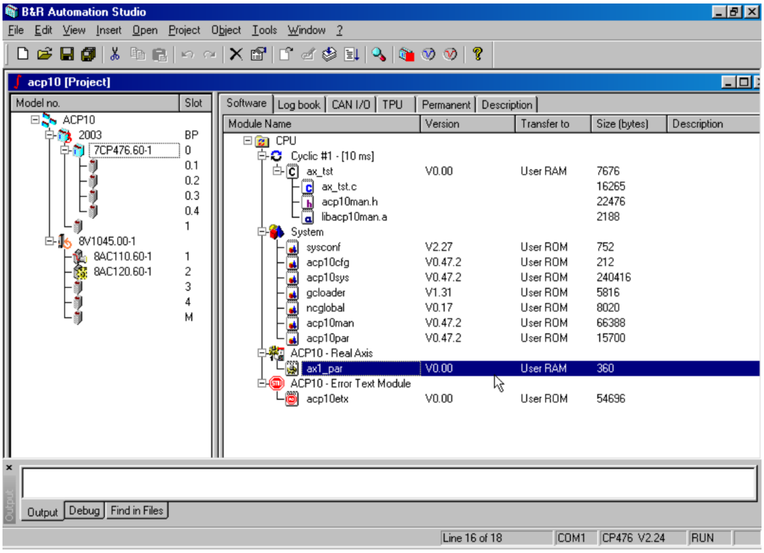
End switch and Quickstop are not wired

If the hardware end switches and Quickstop are not wired, it is possible to change the parameters so that the motor shaft can still be moved.

Danger!

When moving the motor shaft without the hardware end switches connected, movements of mechanical parts mounted on the motor shaft must be considered. Otherwise severe personal injury or damage to property can occur!

- Position the cursor on the initial parameter module AX1_PAR.
- Open the object by double-clicking with the left mouse button.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files
Line 16 of 18
COM1
CP476 V2.24
RUN

Model no.	Slot
ACP10	
2003	BP
7CP476.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.27	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

Figure 75: Open initial parameter module AX1_PAR

- Position the mouse pointer on "dig_in".

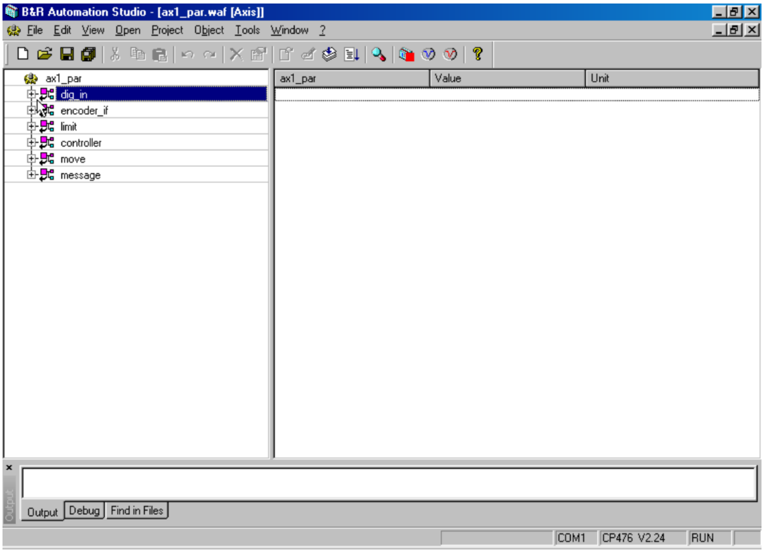

B&R Automation Studio - [ax1_par.waf [Axis]]
File Edit View Open Project Object Tools Window ?
ax1_par
dig_in
encoder_if
limit
controller
move
message
ax1_par
Value
Unit
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

Figure 76: Place the mouse pointer on "dig_in"

- Expand the view by clicking on "+".

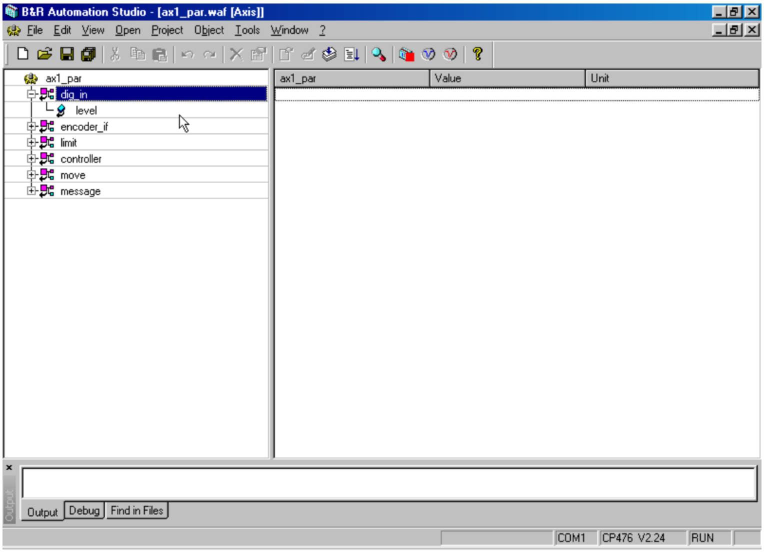
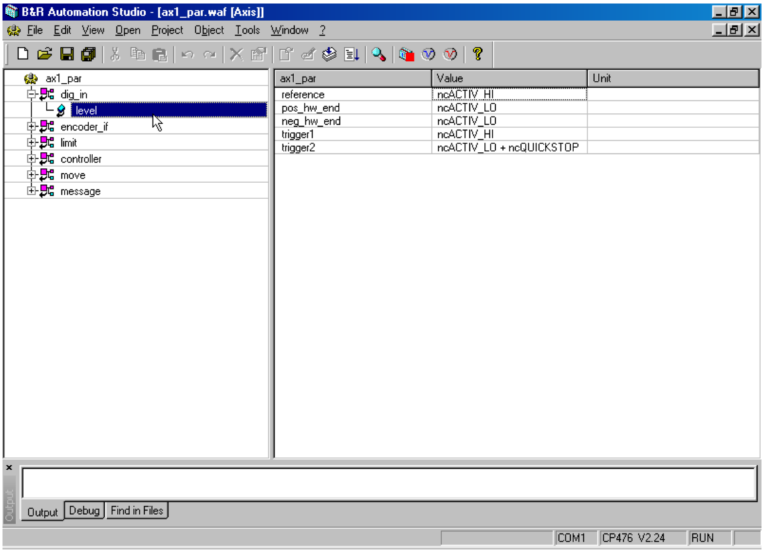

B&R Automation Studio - [ax1_par.waf [Axis]]
File Edit View Open Project Object Tools Window ?
ax1_par
dig_in
level
encoder_if
limit
controller
move
message
ax1_par
Value
Unit
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

Figure 77: Expand the view

- Position the mouse pointer on "level". The parameters are now shown in the right part of the window.


B&R Automation Studio - [ax1_par.waf [Axis]]
File Edit View Open Project Object Tools Window ?
ax1_par
dig_in
level
encoder_if
limit
controller
move
message
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_LO	
neg_hw_end	ncACTIV_LO	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_LO + ncQUICKSTOP	

Figure 78: Displaying the level parameters

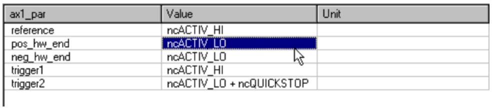
To allow movement of the motor shaft, the following parameters must be changed to the value "ncACTIV_HI":

- pos_hw_end
- neg_hw_end
- trigger2 (Quickstop)

"ncACTIV_HI" means that the inputs for both hardware end switches and the Quickstop are activated (logical "1"). This allows the motor shaft to be moved without wiring the hardware end switches and a Quickstop.

The procedure is shown here in an example for pos_hw_end:

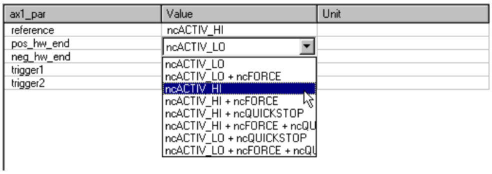
- In the right part of the window, position the mouse pointer on level "ncACTIV_LO" for the shaft parameter pos_hw_end.



ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_LO	
neg_hw_end	ncACTIV_LO	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_LO + ncQUICKSTOP	

Figure 79: Place mouse pointer on level "ncACTIV_LO"

- Open the selection list by clicking with the left mouse button.
- Select "ncACTIV_HI" by clicking with the left mouse button.

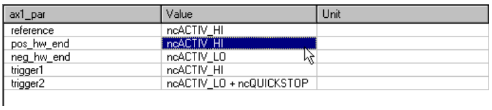


ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_LO	
neg_hw_end		
trigger1		
trigger2		

ncACTIV_LO
ncACTIV_LO + ncFORCE
ncACTIV_HI
ncACTIV_HI + ncFORCE
ncACTIV_HI + ncQUICKSTOP
ncACTIV_HI + ncFORCE + ncQU
ncACTIV_LO + ncQUICKSTOP
ncACTIV_LO + ncFORCE + ncQU

Figure 80: Change the level for the positive hardware end switch

- Acknowledge the selection by pressing the ENTER key.

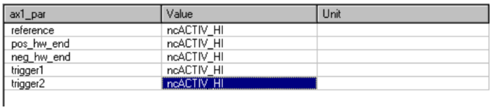


ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_HI	
neg_hw_end	ncACTIV_LO	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_LO + ncQUICKSTOP	

Figure 81: Acknowledge level change

Use the same procedure for the other two parameters, neg_hw_end and trigger2 (Quickstop).

When all changes are made, the value list looks like this:

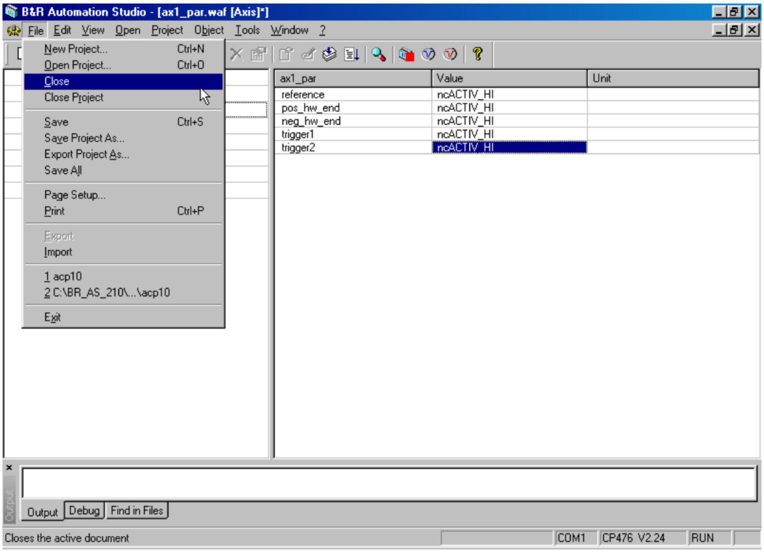


ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_HI	
neg_hw_end	ncACTIV_HI	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_HI	

Figure 82: Levels after all changes are made

Now the object window can be closed.

- In the **File** menu, click on **Close**.

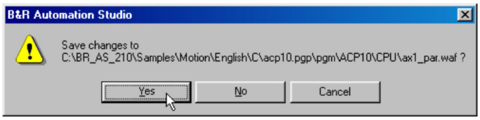

B&R Automation Studio - [ax1_par.waf [Axis]*]
File Edit View Open Project Object Tools Window ?
New Project... Ctrl+N
Open Project... Ctrl+O
Close
Close Project
Save Ctrl+S
Save Project As...
Export Project As...
Save All
Page Setup...
Print Ctrl+P
Export
Import
1 acp10
2 C:\BR_AS_210\...\acp10
Exit
Output
Debug
Find in Files
COM1
CP476 V2.24
RUN

ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_HI	
neg_hw_end	ncACTIV_HI	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_HI	

Closes the active document

Figure 83: Closing the object window

- Acknowledge the changes by clicking the **Yes** button.


B&R Automation Studio
Yes
No
Cancel

Save changes to
C:\BR_AS_210\Samples\Motion\English\C\acp10.pgp\pgm\ACP10\CPU\ax1_par.waf ?

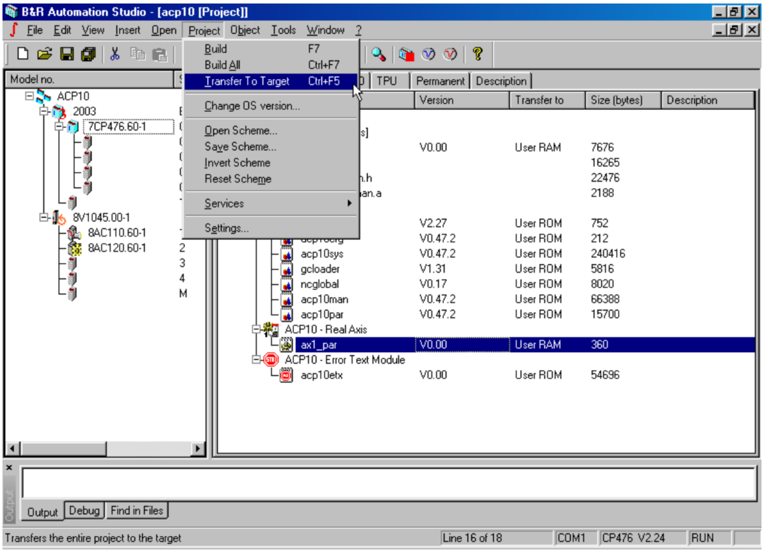
Figure 84: Acknowledge level changes

The project window will be shown again.

2.2.4 Downloading the Project

After making the preparations, the project can now be transferred to the target system:

- In the **Project** menu, click on **Transfer To Target**.


B&R Automation Studio - [acp10 [Project]]
File Edit View Insert Open Project Object Tools Window ?
Build F7
Build All Ctrl+F7
Transfer To Target Ctrl+F5
Change OS version...
Open Scheme...
Save Scheme...
Invert Scheme
Reset Scheme
Services
Settings...
Model no.
ACP10
2003
7CP476.60-1
8V1045.00-1
8AC110.60-1
8AC120.60-1
TPU
Permanent
Description
Output
Debug
Find in Files
Line 16 of 18
COM1
CP476 V2.24
RUN

	Version	Transfer to	Size (bytes)	Description
	V0.00	User RAM	7676	
			16265	
			22476	
			2188	
	V2.27	User ROM	752	
	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.31	User ROM	5816	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

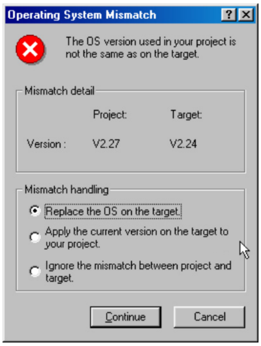
Transfers the entire project to the target

Figure 85: Click on the command to transfer the project to the target system

If an operating system has already been transferred to the PLC, a version conflict could occur.

In this case, the operating system on the PLC is to be replaced by the operating system in the sample project:

- Select **Replace operating system ...** option field.



Operating System Mismatch

The OS version used in your project is not the same as on the target.

Mismatch detail

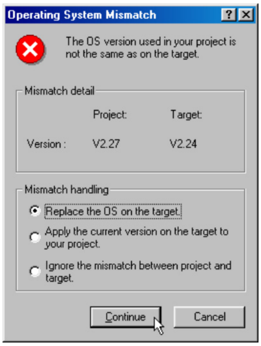
	Project:	Target:
Version :	V2.27	V2.24

Mismatch handling

● Replace the OS on the target.
○ Apply the current version on the target to your project.
○ Ignore the mismatch between project and target.

Figure 86: Operating system version conflict

- Acknowledge by clicking the **Continue** button.



Operating System Mismatch

The OS version used in your project is not the same as on the target.

Mismatch detail

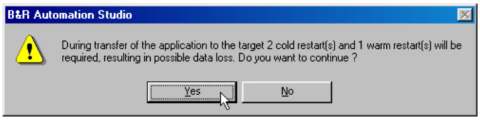
	Project:	Target:
Version :	V2.27	V2.24

Mismatch handling

● Replace the OS on the target.
○ Apply the current version on the target to your project.
○ Ignore the mismatch between project and target.

Figure 87: Acknowledge selection of conflict resolution

- A message will be displayed by B&R Automation Studio™. Acknowledge this message by clicking **Yes**.

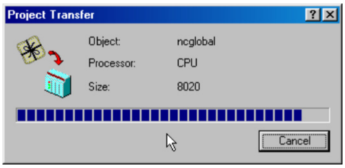


B&R Automation Studio

During transfer of the application to the target 2 cold restart(s) and 1 warm restart(s) will be required, resulting in possible data loss. Do you want to continue ?

Figure 88: Acknowledge message from B&R Automation Studio™ with **Yes**

- The project is transferred.

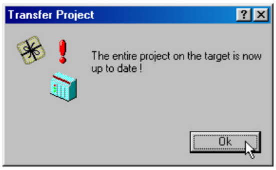


Project Transfer

Object: ncglobal
Processor: CPU
Size: 8020

Figure 89: The project is transferred

- The following message is given after the project has been successfully transferred:



Transfer Project

The entire project on the target is now up to date !

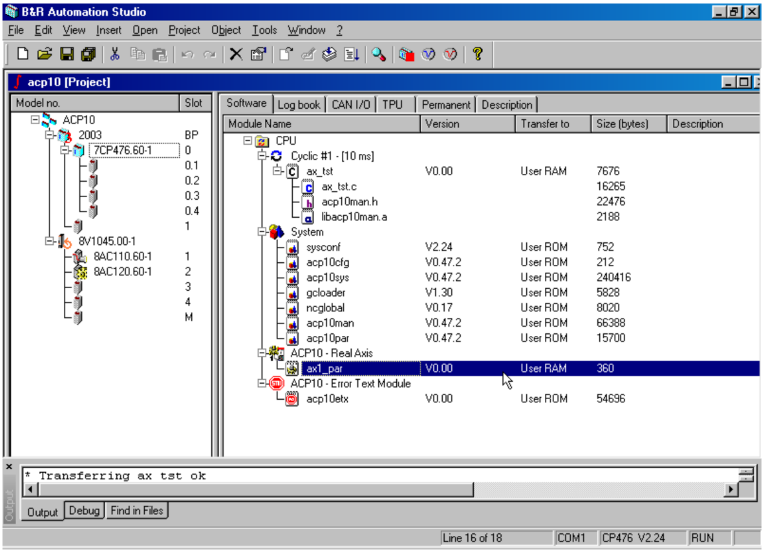
Figure 90: The project was transferred successfully

- Acknowledge the message by clicking the **OK** button.

2.2.5 Test Function

Now control of the motor shaft can be taken over using the test function (ACP10 - real axis):

- Position the cursor on the initial parameter module AX1_PAR.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
acp10 [Project]
Software
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files
Line 16 of 18
COM1
CP476 V2.24
RUN

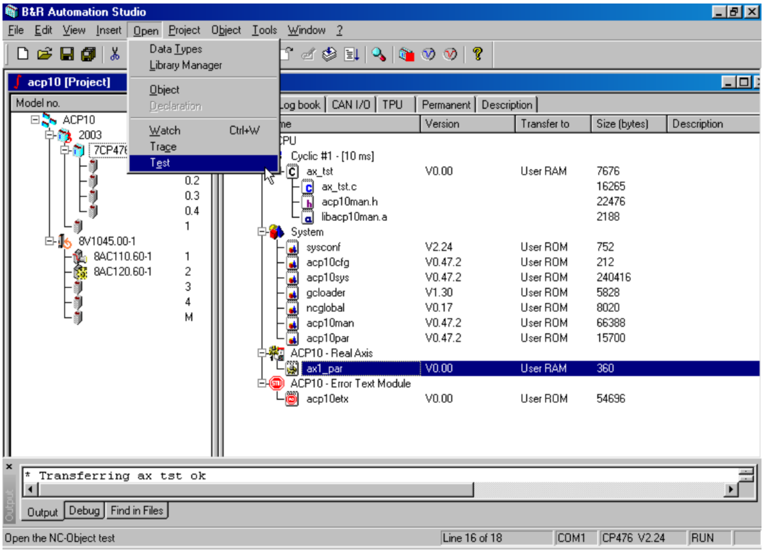
Model no.	Slot
ACP10	
2003	BP
7CP476.60-1	0
	0.1
	0.2
	0.3
	0.4
	1
8V1045.00-1	
8AC110.60-1	1
8AC120.60-1	2
	3
	4
	M

Module Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.24	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.30	User ROM	5828	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

```
* Transferring ax tst ok
```

Figure 91: Select initial parameter module AX1_PAR

- In the **Open** menu, click on **Test**.


B&R Automation Studio
File Edit View Insert Open Project Object Tools Window ?
Data Types
Library Manager
Object
Declaration
Watch Ctrl+W
Trace
Test
acp10 [Project]
Model no.
ACP10
2003
7CP476
8V1045.00-1
8AC110.60-1
8AC120.60-1
Log book
CAN I/O
TPU
Permanent
Description
Output
Debug
Find in Files

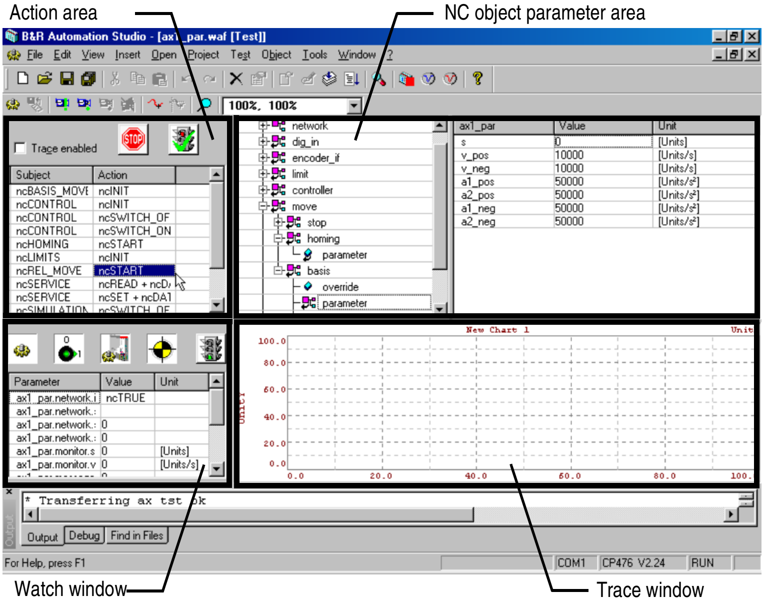
Name	Version	Transfer to	Size (bytes)	Description
CPU				
Cyclic #1 - [10 ms]				
ax_tst	V0.00	User RAM	7676	
ax_tst.c			16265	
acp10man.h			22476	
libacp10man.a			2188	
System				
sysconf	V2.24	User ROM	752	
acp10cfg	V0.47.2	User ROM	212	
acp10sys	V0.47.2	User ROM	240416	
gcloader	V1.30	User ROM	5828	
ncglobal	V0.17	User ROM	8020	
acp10man	V0.47.2	User ROM	66388	
acp10par	V0.47.2	User ROM	15700	
ACP10 - Real Axis				
ax1_par	V0.00	User RAM	360	
ACP10 - Error Text Module				
acp10etx	V0.00	User ROM	54696	

```
* Transferring ax tst ok
```

Open the NC-Object test | Line 16 of 18 | COM1 | CP476 V2.24 | RUN

Figure 92: Command to open the test window

The test window is shown:


Action area
NC object parameter area
B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
Trace enabled
network
dig_in
encoder_if
limit
controller
move
stop
homing
parameter
basis
override
parameter
New Chart 1
Unit
Unit1
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.
Output
Debug
Find in Files
Watch window
Trace window

☐ Trace enabled

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OFF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD
ncSERVICE	ncSET + ncDAT
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	0	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s²]
a2_pos	50000	[Units/s²]
a1_neg	50000	[Units/s²]
a2_neg	50000	[Units/s²]

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

```
* Transferring ax tst ok
```

For Help, press F1 | COM1 | CP476 V2.24 | RUN

Figure 93: Test window for ACOPOS servo drives

2.2.6 Starting the Motor Movement

Danger!

The traverse path must be adjusted for the conditions present (installed mechanical parts, etc.).

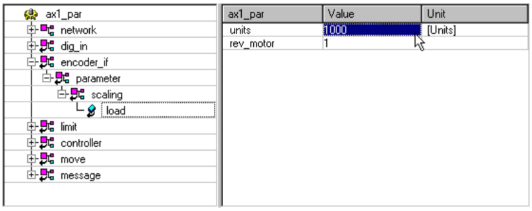
Incorrect control of motors or mechanical parts connected to the motor shaft can cause unwanted and dangerous movements. This can cause severe personal injury or damage to property!

If mechanical parts are mounted on the motor, the number of encoder units per motor revolution must be adjusted to the mechanical characteristics (possible traverse path, etc.).

The number of encoder units per motor revolution (units, rev_motor) can be set as follows:

- Position the mouse pointer on "encoder_if"
- Expand the view by clicking on "+"
- Position the mouse pointer on "parameter"
- Expand the view by clicking on "+"
- Position the mouse pointer on "scaling"
- Expand the view by clicking on "+"
- Position the mouse pointer on "load"

The parameters are now shown in the right part of the window:



ax1_par	Value	Unit
units	1000	[Units]
rev_motor	1	

Figure 94: Setting the encoder resolution

Now the values can be adjusted to the mechanical parts used and acknowledged by pressing the ENTER key.

The new encoder parameters now have to be initialized:

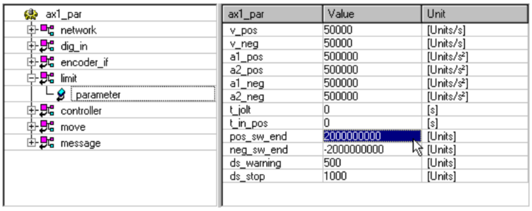
- Action window:
  Position the mouse pointer on the action ncENCODER_IF, ncINIT
- Initialize the new values on the encoder by pressing the button.

For additional safety, the traverse path can be limited using software end switches (pos_sw_end, neg_sw_end).

The software end switches can be defined as follows:

- Position the mouse pointer on "limit"
- Expand the view by clicking on "+"
- Position the mouse pointer on "parameter"

The parameters are now shown in the right part of the window:



ax1_par	Value	Unit
v_pos	50000	[Units/s]
v_neg	50000	[Units/s]
a1_pos	500000	[Units/s^2]
a2_pos	500000	[Units/s^2]
a1_neg	500000	[Units/s^2]
a2_neg	500000	[Units/s^2]
t_jolt	0	[s]
t_in_pos	0	[s]
pos_sw_end	2000000000	[Units]
neg_sw_end	-2000000000	[Units]
ds_warning	500	[Units]
ds_stop	1000	[Units]

Figure 95: Defining the software end switches

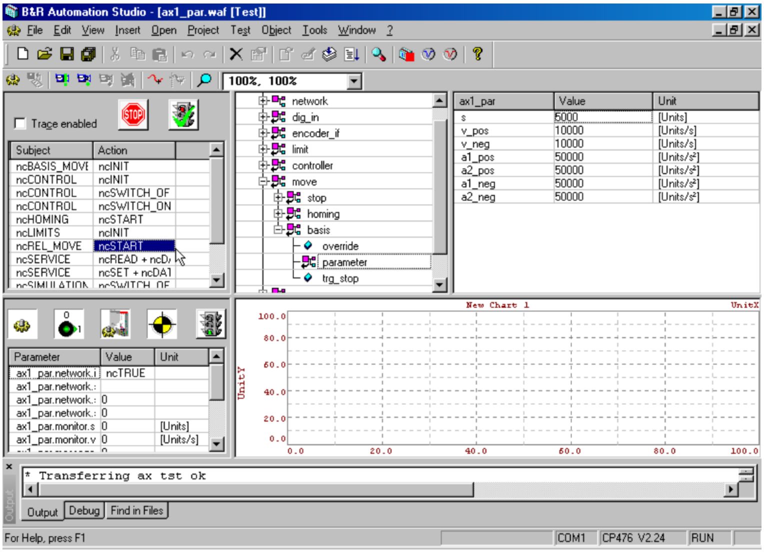
Now the values can be adjusted to the mechanical parts used and acknowledged by pressing the ENTER key.

The new limit values now have to be initialized:

- Action window:
  Position the mouse pointer on the action ncLIMITS, ncINIT
- Initialize the new limit values by pressing the ⚙ button.

Entering the Traverse Path

- Position the mouse pointer on the **action** "ncSTART" for the **subject** "ncREL_MOVE" in the action window.


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
☐ Trace enabled
STOP
network
dig_in
encoder_if
limit
controller
move
stop
homing
basis
override
parameter
trg_stop
New Chart 1
UnitX
UnitY
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
0
1
Output
Debug
Find in Files
Output
For Help, press F1
COM1
CP476 V2.24
RUN

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD/
ncSERVICE	ncSET + ncDA1
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s²]
a2_pos	50000	[Units/s²]
a1_neg	50000	[Units/s²]
a2_neg	50000	[Units/s²]

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

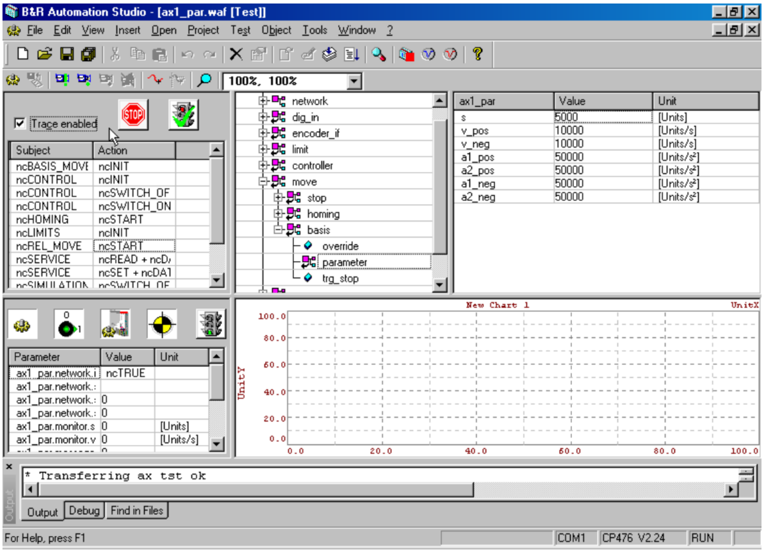
```
* Transferring ax tst ok
```

Figure 96: Place mouse pointer on the **action** "ncSTART"

- Enter the value (e.g. 5000) for s (target position or relative traverse path) in the **parameter** object , **value** column.
- Acknowledge by pressing the ENTER key.
  The value is entered in the axis data structure.

Enabling the Trace Function

- Position the mouse pointer on the **Trace enabled** checkbox in the action window.
- Activate the checkbox by clicking on it with the left mouse button.


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
☑ Trace enabled
STOP
network
dig_in
encoder_if
limit
controller
move
stop
homing
basis
override
parameter
trg_stop
New Chart 1
UnitX
UnitY
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
Output
Debug
Find in Files
For Help, press F1
COM1
CP476 V2.24
RUN

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD/
ncSERVICE	ncSET + ncDA1
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s²]
a2_pos	50000	[Units/s²]
a1_neg	50000	[Units/s²]
a2_neg	50000	[Units/s²]

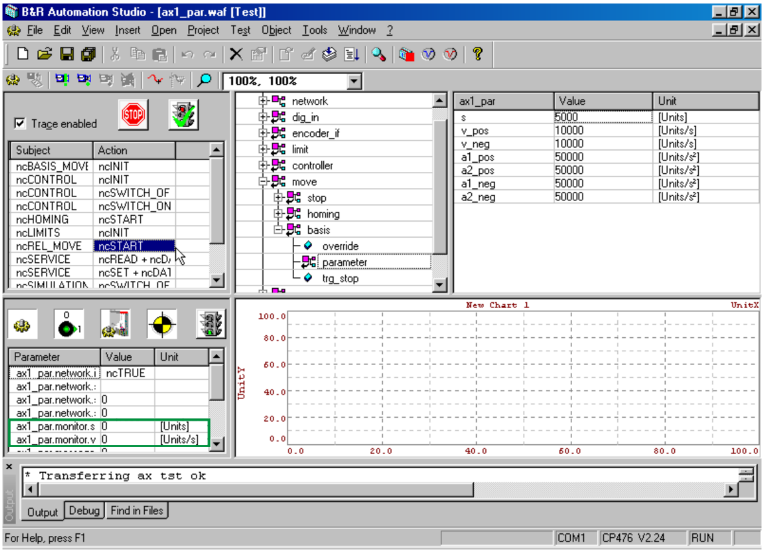
Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

```
* Transferring ax tst ok
```

Figure 97: Enable trace function

Start the Motor Movement

- Position the mouse pointer on the **action** "ncSTART" for the **subject** "ncREL_MOVE" in the action window.


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
network
dig_in
encoder_if
limit
controller
move
stop
homing
basis
override
parameter
trg_stop
New Chart 1
UnitX
UnitY
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
Output
Debug
Find in Files

☑ Trace enabled

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD/
ncSERVICE	ncSET + ncDA1
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s²]
a2_pos	50000	[Units/s²]
a1_neg	50000	[Units/s²]
a2_neg	50000	[Units/s²]

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

```
* Transferring ax tst ok
```

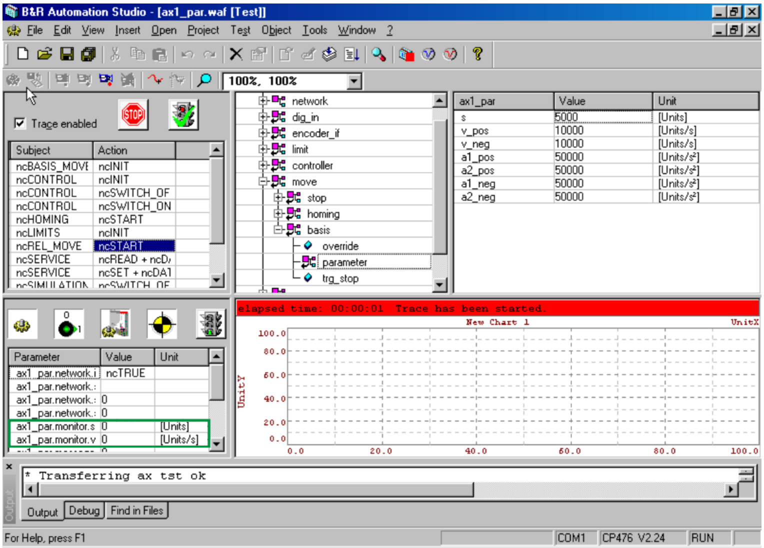
For Help, press F1 | COM1 | CP476 V2.24 | RUN

Figure 98: Place mouse pointer on the **action** "ncSTART"

- Click on the button on the toolbar:

  The motor shaft now moves according to the traverse path (s) defined and the Trace function starts.

Display and Evaluation of the Trace Function


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
network
dig_in
encoder_if
limit
controller
move
stop
homing
basis
override
parameter
trg_stop
New Chart 1
UnitX
UnitY
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
Output
Debug
Find in Files

☑ Trace enabled

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD/
ncSERVICE	ncSET + ncDA1
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s^2]
a2_pos	50000	[Units/s^2]
a1_neg	50000	[Units/s^2]
a2_neg	50000	[Units/s^2]

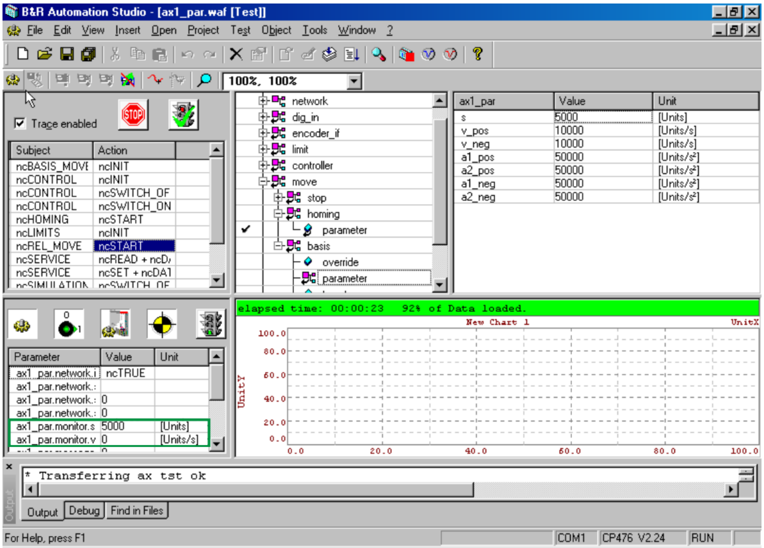
Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

elapsed time: 00:00:01 Trace has been started.

* Transferring ax tst ok

For Help, press F1 COM1 CP476 V2.24 RUN

Figure 99: During the movement of the shaft, the traverse path already completed is shown in the Watch window


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
network
dig_in
encoder_if
limit
controller
move
stop
homing
parameter
basis
override
parameter
New Chart 1
UnitX
UnitY
100.0
80.0
60.0
40.0
20.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
Output
Debug
Find in Files

☑ Trace enabled

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD/
ncSERVICE	ncSET + ncDA1
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s^2]
a2_pos	50000	[Units/s^2]
a1_neg	50000	[Units/s^2]
a2_neg	50000	[Units/s^2]

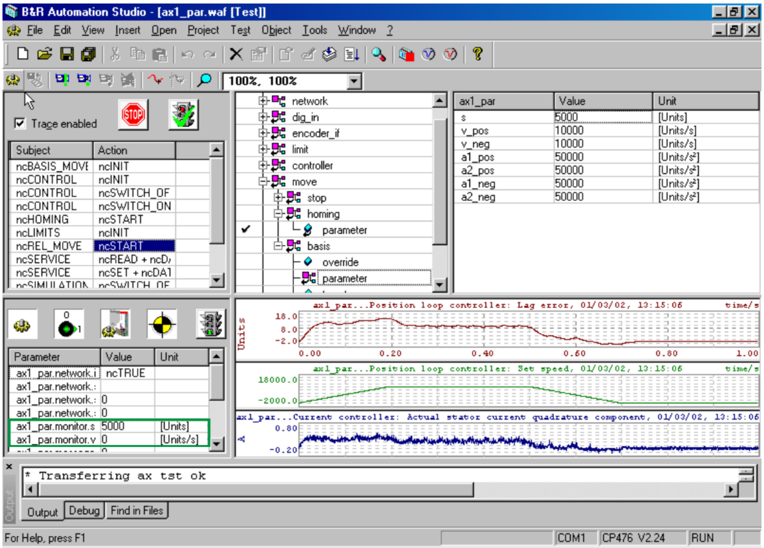
Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	5000	[Units]
ax1_par.monitor.v	0	[Units/s]

elapsed time: 00:00:23 92% of Data loaded.

* Transferring ax tst ok

For Help, press F1 COM1 CP476 V2.24 RUN

Figure 100: The defined traverse path was completed and the Trace data is loaded


B&R Automation Studio - [ax1_par.waf [Test]]
File Edit View Insert Open Project Test Object Tools Window ?
100%, 100%
Trace enabled
network
dig_in
encoder_if
limit
controller
move
stop
homing
parameter
basis
override
parameter
Output Debug Find in Files

Subject	Action
ncBASIS_MOVE	ncINIT
ncCONTROL	ncINIT
ncCONTROL	ncSWITCH_OF
ncCONTROL	ncSWITCH_ON
ncHOMING	ncSTART
ncLIMITS	ncINIT
ncREL_MOVE	ncSTART
ncSERVICE	ncREAD + ncD
ncSERVICE	ncSET + ncDAT
ncSIMULATION	ncSWITCH_OF

ax1_par	Value	Unit
s	5000	[Units]
v_pos	10000	[Units/s]
v_neg	10000	[Units/s]
a1_pos	50000	[Units/s²]
a2_pos	50000	[Units/s²]
a1_neg	50000	[Units/s²]
a2_neg	50000	[Units/s²]

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	5000	[Units]
ax1_par.monitor.v	0	[Units/s]

ax1_par...Position loop controller: Lag error, 01/03/02, 13:15:06 time/s

ax1_par...Position loop controller: Set speed, 01/03/02, 13:15:06 time/s

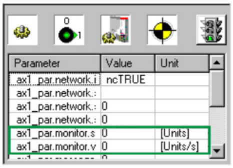
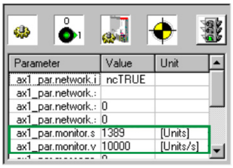
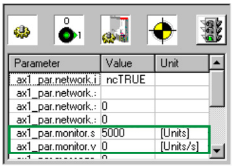
ax1_par...Current controller: Actual stator current quadrature component, 01/03/02, 13:15:06

```
* Transferring ax tst ok
```

For Help, press F1 | COM1 | CP476 V2.24 | RUN

Figure 101: The data recorded is shown in the Trace window

The current position of the motor shaft is shown in the Watch window:

Display of the current position of the motor shaft		
Before the shaft movement	**During the shaft movement**	**After the shaft movement**
		

Before the shaft movement:

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	0	[Units]
ax1_par.monitor.v	0	[Units/s]

During the shaft movement:

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	1389	[Units]
ax1_par.monitor.v	10000	[Units/s]

After the shaft movement:

Parameter	Value	Unit
ax1_par.network.i	ncTRUE	
ax1_par.network.:		
ax1_par.network.:	0	
ax1_par.network.:	0	
ax1_par.monitor.s	5000	[Units]
ax1_par.monitor.v	0	[Units/s]

Table 130: Display of the current position of the motor shaft in the Watch window

The following data concerning shaft movement is displayed in the Trace window:

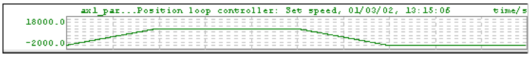
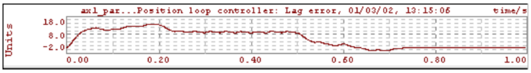
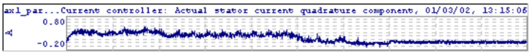
Set Speed
 The acceleration phase, the constant speed phase and the braking phase of the shaft movement can be evaluated here.
Lag Error
 • the lag error increases in the acceleration phase of the motor axis • the lag error remains constant at a constant speed • the lag error decreases in the braking phase
Actual stator current of the quadrature component
 The various movement phases are represented here: • in the acceleration phase of the motor axis: high current • at constant speed: current is reduced • in the braking phase: negative current

Table 131: Output of the recorded data in the Trace window

2.3 Network Command Trace

Network Command Trace is an expansion of the Trace function and is used to provide a representation of communication between the PLC and the connected ACOPOS servo drives. The recorded communication data can be uploaded from the PLC. The evaluation of the communication data can help locate errors if communication disturbances occur between ACOPOS servo drives and the PLC.

Details concerning the operation of Network Command Trace can be found in the online help for B&R Automation Studio™ (section **B&R Software World** --> **Automation Studio** --> **Motion Components** --> **Working with the PLC** --> **Trace** --> **Network Command Trace)**.

Chapter 7 • Standards and Certifications

1. Valid European Guidelines

- EMC guidelines 89/336/EWG
- Low-voltage guidelines 73/23/EWG
- Machine guidelines 98/37/EG

2. Valid Standards

Standard	Description
IEC/EN 61800-2	Adjustable speed electrical power drive systems • Part 2: General requirements; Rating specifications for low voltage adjustable frequency AC power drive systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems • Part 3: EMC product standard including specific test methods
IEC 61800-5 (draft)	Adjustable speed electrical power drive systems • Part 5: Electrical, thermal and functional safety aspects; drive systems with electrically adjustable speed (IEC 22G/CD:1998)
IEC/EN 61131-2	Programmable logic controllers • Part 2: Equipment requirements and tests
IEC 60204-1	Safety of machinery - electrical equipment on machines • Part 1: General requirements
EN 1037	Safety of machinery - prevention of unexpected start-up
IEC 61508	Functional safety of electrical, electronic, programmable electronic systems
IEC 954-1	Safety of machinery - safety-related parts of control systems • Part 1: General design principles 1)
UL 508 C	Industrial control equipment • Part 6: Solid-state AC Motor Controllers

Table 132: Valid standards for ACOPOS servo drives

1) TÜV: Sample test for secure restart inhibit according to EN 954-1 category 3 is in preparation.

The limit values specified from section 3 "Environmental Limits" to section 6 "Other Environmental Limit Values According to IEC 61800-2" are taken from product standard IEC 61800 for servo drives in industrial environments (2nd environment). Stricter test procedures and limit values are used during the type tests for ACOPOS servo drives. Additional information is available from B&R.

3. Environmental Limits

3.1 Mechanical Conditions According to IEC 61800-2

3.1.1 Operation

IEC 60721-3-3, class 3M1	
	IEC 61800-2
Vibration during operation $2 \le f < 9$ Hz $9 \le f < 200$ Hz	 0.3 mm amplitude 1 m/s² acceleration

Table 133: Mechanical conditions during operation

3.1.2 Transport

IEC 60721-3-2, class 2M1	
	IEC 61800-2
Vibration during transport $2 \le f < 9$ Hz $9 \le f < 200$ Hz $200 \le f < 500$ Hz	 3,5 mm amplitude 10 m/s² acceleration 15 m/s² acceleration

Table 134: Mechanical conditions during transport

3.2 Climate Conditions According to IEC 61800-2

3.2.1 Operation

IEC 60721-3-3, class 3K3	
	IEC 61800-2
Environmental temperature during operation	5 to 50° C
Relative humidity during operation	5 - 85%, non-condensing

Table 135: Climate conditions during operation

3.2.2 Storage

IEC 60721-3-1, class 1K4	
	IEC 61800-2
Storage temperature	-25 to +55 °C

Table 136: Climate conditions (temperature) during storage

IEC 60721-3-1, class 1K3	
	IEC 61800-2
Relative humidity during storage	5 - 95%, non-condensing

Table 137: Climate conditions (humidity) during storage

3.2.3 Transport

IEC 60721-3-2, class 2K3	
	IEC 61800-2
Transport temperature	-25 to +70° C
Relative humidity during transport	95% at +40° C

Table 138: Climate conditions during transport

4. Requirements for Immunity to Disturbances (EMC)

4.1 Evaluation Criteria (performance criteria)

Criteria A ...... Test object not influenced during test.

Criteria B ...... Test object only temporarily influenced during test.

Criteria C ...... The system does not reboot automatically (reset required).

4.2 Low Frequency Disturbances According to IEC 61800-3

The following limits are valid for industry (2^{nd} environment).

4.2.1 Power Mains Harmonics and Commutation Notches / Voltage Distortions

IEC 61000-2-4, class 3		
	IEC 61800-3	**Performance Criteria**
Harmonics	THD = 10 %	A
Short harmonics (< 15 s)	1.5x continuous level	B

Table 139: Limits for power mains harmonics

IEC 60146-1-1, class 3		
	IEC 61800-3	**Performance Criteria**
Commutation notches	Depth = 40%, Total area = 250% x degree	A

Table 140: Limit values for commutation notches / voltage distortions

4.2.2 Voltage Changes, Deviations, Dips and Short-term Interruptions

IEC 61000-2-4, class 3		
	IEC 61800-3	**Performance Criteria**
Voltage changes and deviations	± 10 %	A
Voltage changes and deviations (< 1 min)	+ 10% to - 15%	

Table 141: Limit values for voltage changes and deviations

IEC 61000-2-1		
	IEC 61800-3	**Performance Criteria**
Voltage dips and short-term interruptions	10% to 100%	C

Table 142: Limit values for voltage dips and short-term interruptions

4.2.3 Asymmetric Voltage und Frequency Changes

IEC 61000-2-4, class 3		
	IEC 61800-3	**Performance Criteria**
Asymmetric voltages	3% negative component	A
Frequency change and change rate	± 2%, 1%/s (±4%, 2%/s if the power supply is isolated from general power mains)	

Table 143: Limit values for asymmetric voltages and frequency changes

4.3 High Frequency Disturbances According to IEC 61800-3

These immunity tests are valid for industrial environments (2nd environment).

4.3.1 Electrostatic Discharge

Tests according to IEC 61000-4-2		
	IEC 61800-3	**Performance Criteria**
Contact discharge to powder-coated and bare metal housing parts	6 kV	B
Discharge through the air to plastic housing parts	8 kV	

Table 144: Limits for electrical discharge

4.3.2 Electromagnetic Fields

Tests according to IEC 61000-4-3		
	IEC 61800-3	**Performance Criteria**
Housing, completely wired	80 MHz - 1 GHz, 10 V/m, 80 % amplitude modulation at 1 kHz	A

Table 145: Limits for electromagnetic fields

4.3.3 Burst

Tests according to IEC 61000-4-4		
	IEC 61800-3	**Performance Criteria**
Power connection	2 kV, 1 min, direct coupling	B
Lines for measurement and control functions in the process environment	2 kV, 1 min	
Signal interfaces, other lines	1 kV, 1 min	

Table 146: Limits for burst

4.3.4 Surge

Tests according to IEC 61000-4-5		
	IEC 61800-3	**Performance Criteria**
Power connection	1 kV (2 Ω) 1) , DM, symmetrical 2 kV (12 Ω) 1) , CM, unsymmetrical	B

Table 147: Limits for surge

1) The impedance was added from IEC 61000-4-5 because it is not defined in IEC 61800-3.

4.3.5 High Frequency Conducted Disturbances

Tests according to IEC 61000-4-6		
	IEC 61800-3	**Performance Criteria**
Power connection	0.15 - 80 MHz, 10 V, 80 % amplitude modulation at 1 kHz	A
Lines for measurement and control functions in the process environment		
Signal interfaces, other lines		

Table 148: Limits for conducted disturbances (radio frequency)

5. Requirements for Emissions (EMC)

5.1 High Frequency Emissions According to IEC 61800-3

These emissions tests are valid for industrial environments (2nd environment).

5.1.1 Emissions on the Power Connections

Tests according to IEC 55011			
Continuous Current on Motor	**Frequency Range [MHz]**	**Quasi-peak Value**	**Average**
I ≤ 100 A	0.15 ≤ f < 0.5	100 dB (µV)	90 dB (µV)
	0.5 ≤ f < 5	86 dB (µV)	76 dB (µV)
	5 ≤ f < 30	90 dB (µV)	80 dB (µV)
100 A < I	0.15 ≤ f < 0.5	130 dB (µV)	120 dB (µV)
	0.5 ≤ f < 5	125 dB (µV)	115 dB (µV)
	5 ≤ f < 30	115 dB (µV)	105 dB (µV)

Table 149: Limits for emissions on the power connections

5.1.2 Electromagnetic Emissions

Tests according to IEC 55011	
Frequency Range [MHz]	**Quasi-peak Value**
30 ≤ f ≤ 230	40 dB (µV/m), measured at distance of 30 m 1)
230 < f ≤ 1000	50 dB (µV/m), measured at distance of 30 m1)

Table 150: Limits for electromagnetic emissions

1) The limit values were increased by 10 dB (µV/m) when measuring from distances of 10 m.

6. Other Environmental Limit Values According to IEC 61800-2

	IEC 61800-2
Degree of pollution according to IEC 61800-2, 4.1.2.1.	2
Over-voltage category according to IEC 60364-4-443:1999	II
Protection according to IEC 60529	IP20
Reduction of the continuous current at installation altitudes over 500 m above sea level	10% per 1000 m
Maximum installation altitude	2000 m 1)

Table 151: Additional environmental limits

1) Additional requirements are to be arranged with B&R.

7. International Certifications

B&R products and services comply with the applicable standards. They are international standards from organizations such as ISO, IEC and CENELEC, as well as national standards from organizations such as UL, CSA, FCC, VDE, ÖVE, etc. We give special consideration to the reliability of our products in an industrial environment.

Certifications	
USA and Canada C UL US	All important B&R products are tested and listed by Underwriters Laboratories and are checked quarterly by a UL inspector. This mark is valid for the USA and Canada and eases certification of your machines and systems in these areas.
Europe CE	All harmonized EN standards for the valid guidelines are met.
Russian Federation РСТ	GOST-R certification is available for the export of all B&R ACOPOS servo drives in the Russian Federation.

Table 152: International Certifications

8. Standards, Definitions for Safety Techniques

Stop functions according to IEC 60204-1/11.98 (electrical equipment for machines, part 1: general requirements)

The following three stop function categories exist:

Category	Description
0	Stop by immediately switching off the power to the machine drive elements (i.e. uncontrolled stop).
1	A controlled stop, the power to the machine drive elements remains on until the stop procedure is completed. The power is switched off after the stop is complete.
2	A controlled stop, the power to the machine drive elements is not switched off.

Table 153: Overview of stop function categories

The necessary stop functions must be determined based on a risk evaluation for the machine. Stop functions in category 0 and category 1 must be able to function regardless of the operating mode. A category 0 stop must have priority. Stop functions must have priority over assigned start functions. Resetting the stop function is not allowed to cause a dangerous state.

Emergency stops according to IEC 60204-1/11.98 (electrical equipment for machines, part 1: general requirements)

The following requirements are valid for emergency stops in addition to the requirements for the stop functions:

- It must have priority over all other functions and operations in all operating modes.
- The power to the machine drive elements which can cause a dangerous state must be switched off as quickly as possible without creating other dangers.
- Resetting is not allowed to cause a restart.

Emergency stops must be category 0 or category 1 stop functions. The necessary stop function must be determined based on a risk evaluation for the machine.

For emergency stop function in stop category 0, only hard wired, electromechanical equipment can be used. Additionally, the function is not allowed to depend on electronic switching logic (hardware or software) or the transfer of commands via a communication network or data connection. 1)

---

1) In accordance to the national foreword for the valid German version of IEC 60204-1/11.98, it is determined that electronic equipment (and also especially for emergency stop systems) can be used regardless of the stop category, if e.g. it provides the same safety using the standards EN 954-1 and/or IEC 61508 as required by IEC 60204-1.

When using a category 1 stop function for the emergency stop function, it must be guaranteed that the power to the machine drive elements is completely switched off. These elements must be switched off using electromechanical equipment [1] .

Safety category according to EN 954-1/03.97 (safety of machines - safety related parts of control systems, part 1: general design principles) [2]

The safety related parts of control systems must meet one or more of the requirements for five defined safety categories. The safety categories define the required behavior of safety related controller parts regarding their resistance to errors.

Safety Category (according to EN 954-1)	Safety integrity level - SIL (according to IEC 61508-2)	Short Description	System Behavior
B	---	Safety related parts must be designed and built so that they can meet the expected operational requirements. (No specific safety measures are implemented.)	**Caution!** **An error can cause the safety function to fail.**
1	1	Safety related parts must be designed and built so that only reliable components and safety principles are used. (e.g. preventing short circuits by using sufficient distances, reducing the probability of errors by over-dimensioning components, defining the failure route - closed-circuit current principle, etc.)	**Caution!** **An error can cause the safety function to fail.**
2	1	Safety related parts must be designed so that their safety functions are checked in suitable intervals by the machine controller. (e.g. automatic or manual check during start-up)	**Caution!** **An error between checks can cause the safety function to fail. If the safety function fails, it will be recognized during the check.**
3	2	Safety related parts must be designed so that individual errors do not cause the safety function to fail. Individual errors should - if possible - be recognized the next time (or before) the safety function is required.	**Caution!** **The safety function remains active when an error occurs. Some, but not all errors are recognized. A buildup of errors can cause the safety function to fail.**
4	3	Safety related parts must be designed so that individual errors do not cause the safety function to fail. Individual errors must be recognized the next time (or before) the safety function is required. If this type of recognition is not possible, a buildup of errors is not allowed to cause the safety function to fail.	**Information:** **The safety function remains active when an error occurs. Errors are recognized in time to prevent the safety function from failing.**

Table 154: Safety category overview

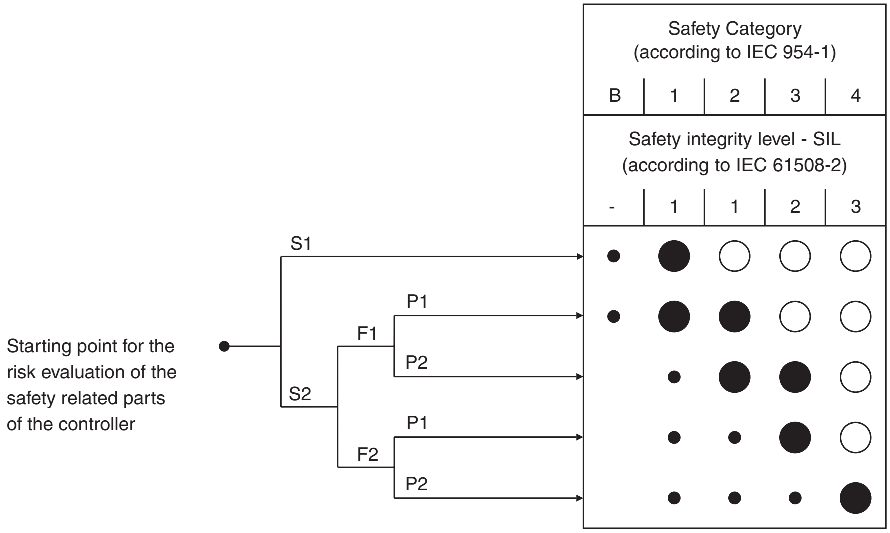
---

1) In accordance to the national foreword for the valid German version of IEC 60204-1/11.98, it is determined that electronic equipment (and also especially for emergency stop systems) can be used regardless of the stop category, if e.g. it provides the same safety using the standards EN 954-1 and/or IEC 61508 as required by IEC 60204-1.

2) To prevent confusing EN 951-1 categories with IEC 60204-1 stop categories, the term "safety categories" was used in the text shown above for EN 954-1 categories.

Selecting the suitable safety category must be done separately for each ACOPOS servo drive (or for each shaft) based on a risk evaluation. This risk evaluation is a part of the total risk evaluation for the machine.

The following risk graph (according to EN 954-1, Appendix B) provides a simplified procedure for risk evaluation:


Safety Category
(according to IEC 954-1)
B
1
2
3
4
Safety integrity level - SIL
(according to IEC 61508-2)
-
1
1
2
3
S1
P1
F1
P2
S2
P1
F2
P2
Starting point for the risk evaluation of the safety related parts of the controller

B, 1 to 4	Safety categories for safety related parts of controllers
●	Preferred categories
•	Possible categories which require extra measures
○	Measure which may be over-dimensioned with regard to the actual risk

Figure 102: Risk graph according to EN 954-1, Appendix B

Begin at the starting point shown and follow the parameters S, F and P to the safety category to be used.

Parameter S ... Seriousness of injury	
S1	Light (usually reversible) injury.
S2	Serious (usually irreversible) injury.
Parameter F ... Frequency and/or duration of the danger exposure	
F1	Seldom to slightly more frequent and/or short exposure duration.
F2	Frequent to continuous and/or long exposure duration.
Parameter P ... Possibility to prevent danger	
P1	Possible under some conditions.
P2	Nearly impossible.

Table 155: Parameters S, F and P lead you to the safety category to be used

Restart inhibit according to EN 1037/04.96 (Safety of machinery - prevention of unexpected start-up)

Keeping a machine in an idle state when people are working in the danger zone is one of the most important requirements for safe operation of machines.

Starting refers to the transition of a machine or its parts from an idle state to moving state. Any start is unexpected if it is caused by:

- A start command sent because of a controller failure or because of external influences on the controller.
- A start command sent because of incorrect operation of a start element or another part of the machine.
- Restoration of power supply after an interruption.
- External/internal influences on parts of the machine.

To prevent unexpected starting of machines or parts of machines, power should be removed and dissipated. If this is not practical (e.g. frequent, short work in danger zone), other measures must be taken:

- Measures to prevent random start commands.
- Measures to prevent that random start commands cause unexpected starting.
- Measures to automatically stop dangerous parts of the machine before a dangerous situation can be caused by unexpected starting.

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